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NOTES ON THE LITTLE BULLDOG BAT, DIRIAS ALBIVENTER MINOR (OSGOOD), IN PANAMA

BY LAWRENCE H. DUNN

During the past thirty-two months I have obtained specimens of the little bulldog bat, *Dirias albiventer minor*, in Panama on five occasions.

In the literature at hand I have found records of only a few specimens of this bat, taken in northern South America. Osgood (1) described the species from a specimen collected at Encontrados, Venezuela, by Dearborn in 1908, and the same writer (2) records two more specimens taken at El Panorama in western Venezuela in 1910. Only two specimens seem to have been previously reported from Panama. Both of these were taken near Empire, Canal Zone, by Goldman (3) in 1912, one shot while in flight with several others at dusk, and the other captured when it flew into living quarters during the evening.

The first specimen seen by me was an adult male that was captured in the grounds of the Panama Hospital in the city of Panama on March 17, 1931. The gardener at the hospital noticed this bat hanging in the dense foliage of a mango tree at about 10 a.m., and after knocking it from the tree with a stick brought it to me. It was injured so badly that it died the following day.

My next specimens were obtained at Summit, Canal Zone. Having been informed that there were many bats present in a house at Summit, I visited this place on September 20, 1932, in company with Mr. James E. Jacob and one assistant.

The building was a large, two-story, wooden tenement house in which a number of Panamanian and West Indian laborers lived with their families. The bath room on the second floor of this house was about ten feet distant from the main part of the building but was connected with the veranda of the main structure by a roofed bridge-like passageway screened on the sides, as was the rest of the house. This arrangement left the attic of the main part of the house separate from that over the bath rooms. The latter attic was

about twelve feet square and four and a half feet high at the center, and sloping on the four sides.

It was in this small attic over the bath rooms that the bats were roosting. They could easily be located by the strong odor of their excrement and by the musky smell of the animals themselves that pervaded the air, as well as by the protesting squeaks they emitted when the rays of our electric flash lights were turned on them. A momentary illumination with our lights revealed their presence in considerable numbers.

By squeezing through a small hole we were able to enter the attic. There were some bats present on each of the four sloping sides of the roof but the greater number were congregated near the eaves in the south-east corner where they were hanging in masses on the rafters and other timbers. This part of the attic in which they were located was too low for a net to be used, which made it necessary for one of us to lie flat and wriggle over the ceiling joists to get within arm's length of the bats and pick them from their hanging places with gloved hands. I tried this first and succeeded in getting in a position where I could collect a few, but owing to the close quarters I was unable to reach the large masses. Since the first few captured, when examined by the rays of the flashlights, appeared to be specimens of *Dirias* and *Molossus*, I was desirous of securing a good number of them. My assistant next crawled under the lower slope of the roof and being of slim build he was able to reach the large masses and collect them by the handfuls. As he grasped a number of the bats in his gloved hand he passed them over his back to where I could reach them and pass them on to the cage which was held by Mr. Jacob, who operated the door of the cage and also held the light directed on our activities. On one occasion my assistant caught fifteen of the bats in one grasp with one hand and later took eight in another handful. Some were caught by a wing or a leg only but this usually sufficed to hold them, since they did not struggle very vigorously to escape. They were ready and powerful biters, however, and frequently it was necessary to jerk our gloves loose from their strong canine teeth to prevent them from piercing the leather. In removing them from the rafters or in passing them to each other in handfuls some were dropped and these shuffled over the boards to seek a hiding place. Only a short time was required to collect as many specimens as was desired and this was fortunate since the heat in the attic was intense. The tropical sun shining on the galvanized iron roof of the attic undoubtedly produced a terrific heat during the middle of the day, yet the bats were hanging very close to the metal roofing and some of them must have been practically in contact with it.

The boards forming the ceiling of the bathrooms were the only flooring of the attic and these were nearly everywhere covered with from two to eight inches of bat excrement. In the southeast corner, where most of the bats were hanging, the guano was practically even with the top edges of the eight

inch ceiling joists. In this area the guano was decidedly moist, probably from the urine of the bats, and it gave off a strong stench. The amount of excrement present would indicate that the attic had been inhabited by the bats for a considerable time. Hundreds of cockroaches and large black beetles were present in this guano.

During the collecting of these bats, many of those that were nearest the eaves of the attic crawled out beneath the roofing and took flight. An observer who counted those leaving the east side of the roof noted 138 leaving during the first few minutes.

On returning to the laboratory and examining our catch we found that we had 123 *Dirias albiventer minor* and 30 *Molossus coibensis*. It was thus evident that these two species live in the closest of companionship.

Of 123 *Dirias*, 39 were males and 84 were females. The teats of a number of the females were large and dark colored and had the appearance of having been lactating at a comparatively recent period. Although there were no noticeably immature specimens in the group it is probable that some of them were young adults. Since the males and females were hanging together in masses in the attic it is clear that with this species the males do not always roost apart from the females.

Fifty of these *Dirias* were disposed of by placing each in a glass jar, where it was chloroformed. This was done to obtain their ectoparasites and to prepare the specimens for our collection. The other 73 were placed in four cages to be kept alive for observation.

There were two color phases. Twelve were a bright russet color on the dorsum while the others were mainly dark brown, with a few showing areas of lighter brown about their shoulders. The ventral surface also showed as much, if not more, variation in color than the dorsal surface and ranged from tan to bright yellowish brown and on to buffy white, with areas of bright orange on the sides below the axillae. The "narrow, whitish median streak from the interscapular region backward," mentioned by Osgood in his description of this species was present in nearly all of those of the darker phase but was lacking in most of the lighter colored specimens.

The light colored individuals, both males and females, were separated from the darker ones and placed in a cage by themselves. This was done to observe any changes that might occur that would help to explain the cause of the two color phases. The possibility of sexual activity having an effect on the color was considered but no evidence was obtained that would indicate this in any way. Unfortunately, none of these bats remained alive in captivity long enough for any salient observations along these lines to be made. Measurements of examples of both phases showed no marked differences, and skulls from individuals of each color agreed closely with each other.

The *Dirias* gave off the most offensive odor of any bat that I have yet observed. It was a strong odor of musk that was decidedly disagreeable

and when a number of them were confined in a room with closed windows, this smell was almost nauseating. After I had handled a number of dead specimens and had rubbed their hair in search of ectoparasites an odor was left on my hands that remained for nearly three days, despite vigorous washing and applications to remove it. Goodwin (4), in writing of a somewhat similar odor that he noted on *Noctilio leporinus mastivus*, a relative of *Dirias*, states: "I noted that the musky odor of *Noctilio* taken at Botany Bay, though strong, was not objectionable, although a specimen taken at Vega Baja, Porto Rico, in February, had a very offensive smell which seemed to cling to my hands for days." It appeared to me that the odor present on the *Dirias* was much more pronounced in the males than in the females. In both sexes the axillae were rather deep and bare and what seemed to be a very small, pocket-like depression extending between the skin and the alar membrane beneath each axilla was noted. This depression and the skin and hair surrounding it were usually coated with a yellowish, greasy substance that appeared to be of about the same consistency as a thick oil. This substance had a very strong odor and it may have been the source of the musky odor emitted by these bats. No glands opening into these sub-axillary pockets could be detected by gross examination but minute ones may have been present to secrete this oily substance.

An interesting formation of the scrotum present in this species has not been observed in any other bat and may be worthy of mention. The scrotum of a male with the testes withdrawn into the perineum is bare, small and inconspicuous. Upon closer examination, however, a wrinkled, slit-like fold of skin extending nearly vertically across either side of the scrotum may be detected. When a testicle is protruded into the scrotum the outer side of this fold moves back to form a crescent shaped ridge about the outer lateral side of the scrotum. The edge of this ridge bears a row of small, but conspicuous, cylindrical protuberances that appear as a crescent-shaped row of minute, elongated warts extending about the outer edge of either side of the scrotum. When a testicle is protruded the skin forming the front of the scrotum within this crescent shaped ridge appears very thin and has more the appearance of a serous membrane than of a true epidermis. When a testicle is withdrawn into the perineum this thin portion of the scrotum is drawn within the latter like an inverted pouch. The crescent-shaped outer ridge studded with the tiny warts is drawn together in a pucker as the opening of a tobacco sack may be closed and the small warts are folded inside and practically are hidden from view. To some extent this outer fold resembles an eyelid in formation and action. This formation when open may be viewed only in living bats that apparently are rutting. The sack-like recess on either side of the scrotum was always found to be closed at the death of the bat. The testes of a freshly killed bat may be protruded by pressure and a piece of thread tied about the scrotum behind them holds them in position, with the fold of skin open to allow for its examination.

At the laboratory these bats were confined in cages about 20 inches square, with the four sides and the top made of wire netting of one-half inch mesh. About 20 bats were placed in each cage. Nearly all of those in each cage gathered to hang in a compact mass from the top of the cage and they usually selected a corner of the cage as a site from which to hang. Thus crowded together, each bat hung head downward and crowded against its fellows from the wire screen at the top of the cage by either one or both feet. When not on the alert their long, pointed ears were folded backward and somewhat outwardly. The bats apparently were but little disturbed by the presence of humans and did not raise their heads to gaze at any one walking about the cages as some other species of bats do. They remained practically motionless during the day and showed what seems to be the sleep of bats more than any other species that I have observed in captivity.

Various foods were offered them, but without much success. Some few seemed to eat nearly any kind of food that was given them for two or three nights, while others did not. It was apparent from the amounts eaten each night that all, or even the greater number of them, never confined themselves to any one particular kind of food. Various fruits, such as orange, banana, papaya, etc., as well as milk, blood, blood clot, Hamburg steak, hard-boiled eggs, and pieces of small fish were offered to them in an effort to determine what diet would suffice them under laboratory conditions. A little of nearly each kind of food offered was eaten but not in amounts to denote that they relished it. Frequently in the early evening, before it really became dusk, individuals might be seen scrambling down the side of the cage to feed. When eating Hamburg steak it was noted that a smacking sound accompanied their vigorous chewing. Cockroaches and moths were placed in the cages but were never eaten, although *Dirias* undoubtedly is normally insectivorous, since the samples of guano taken from the attic were found to be composed almost entirely of minute fragments of insect chitin. These fragments were too small for classification other than to determine that pieces of the elytra of beetles formed a considerable part of the guano.

That these bats digested their food very rapidly was evident. Observations along this line were made on several occasions when a change of food, such as hard-boiled eggs, that could be easily distinguished in the feces, was given. Egg eaten after 5 p.m. could be detected in the excrement in the cage when observed at 8 a.m. the following morning. This would indicate that at least some of their food is digested and excreted within fifteen hours.

After the first few days in captivity the bats began to die off. Each day a few were found dead in the cages, some lying on the floor of the cages while others frequently were found to be dead but still suspended from the top of the cage and hanging only by the curved nails of their toes. Only three of these bats survived thirty-one days in captivity. The last survivor lived thirty-eight days.

It was noted during the collecting of these bats that although they scrambled about on all fours (feet and wrists) none of them made any attempt to fly within the attic. Later while they were in the cages in the laboratory a number of individuals were seen to apparently lose their footholds on the top of the cage through overcrowding and they would then fall to the floor of the cage and land with a distinct "plop." There did not seem to be any attempt made to use their wings to break the fall. This aroused my suspicion that these bats were unable to rise from the ground or take to flight from a low elevation and were thus similar in flight habits to the California mastiff bat (*Eumops californicus*), as observed by Howell (5), who in writing on this subject states, "The probable explanation for this is that unusually active individuals, or those which for some reason are in an unusually active condition, can take wing from low situations, but that the majority, especially during the cooler parts of the year, need to gain momentum by taking a long dive, before flying."

A few trials to test the ability of the *Dirias* to start flight from a low elevation were undertaken. The first few of these trials were conducted in a room in the laboratory. This room was about 20 feet long by 14 feet wide and with the ceiling about 15 feet from the floor. The walls were finished in white and the floor was of light colored tiles. Six windows admitted plenty of light.

When placed on the floor of this room the bats either remained entirely motionless or slowly shuffled about in search of something upon which they could climb with a backward crawl. Gently pushing them about on the floor resulted in some slight acceleration of their crawling movements but did not cause them to make any attempt at flight. Several that were placed on a table and gently pushed over the edge, one at a time, fell to the floor as limp as old gloves.

A number of them were thrown in the air nearly to the ceiling and only three made the slightest effort to save themselves from falling and striking the floor with considerable force. One that had been thrown up several times opened its wings on one occasion and glided down to cling to the leg of a table. Two others partly extended their wings and made a few slight motions to cause a falling leaf movement on the way down to ease their landing. During the first of these flight observations in this room, several of the bats were killed by their falls on the floor. A net was later used to break their fall and prevent them from striking the floor. If one of the bats was taken by the end of a wing and thrown rather forcibly in the air it would slap against the ceiling with some force. Other tests made out of doors during the daytime gave somewhat similar results. The bats remained motionless when placed on the ground and if pushed slightly they clung to the grass and evinced no desire to move. If held loosely in a gloved hand at arm's length over my head they clung to the glove and attempted to crawl about to reach the side of the glove that would provide the most shade. If tossed in the air to a height of less than about fifteen feet they fell back to the ground as though

lifeless. When thrown to a greater height they usually fluttered their wings to glide and wheel to either return to the ground or reach the side of a nearby building or fence to which they hung for a few seconds before falling to the ground. None was noted to make any efforts toward an upward flight.

While I was discussing with Mr. Jacob, who had assisted in the collecting of these bats, regarding their refusal or apparent inability to fly during the trials I had made, he suggested the possibility of their being so confused by handling and exposure to light that they were reluctant to take flight. Acting upon this suggestion I took one of the bats out of doors at early dusk and placed it on a concrete platform in the laboratory yard. It immediately crawled to a nearby wall and began its backward ascension. On being taken from the wall and placed on the grass of the lawn, it remained still for about twenty seconds when, on being touched with my finger, it gave a spring that covered about two linear feet of space and then immediately took flight. It flew in a slow, low flight about three or four feet above the ground until it reached a concrete wall about six feet high about seventy-five feet away from the starting place. The bat ascended and soared over the wall and then continued in a straight, gradually ascending, slow flight until it disappeared from view.

A second bat was then placed on the concrete platform and like the previous one, it crawled a few feet to the side of a building and began crawling up the wall. On being returned to the concrete again it began jumping and fluttering its wings and covering a distance of from six to thirty inches at each jump. It was then removed to the lawn and as soon as placed on the grass it immediately took wing without any preliminary efforts and flew for a distance of about 150 feet before it ascended more than six feet above the ground. It then soared higher and entered some trees.

Several more of these bats were tested out of doors at dusk and later, and all took flight from the lawn without any apparent difficulty. Four others were tested out on the concrete. Two flew after several preliminary springs. One continued jumping until it reached the grass before taking off and the other jumped to the edge of the concrete and began flight from there. The last one to be tested was taken out of doors shortly after a rain while the sky was still cloudy and very dull. When placed on the concrete platform it gave a spring and then flew for several yards at a height of not more than eighteen inches above the floor and circled enough to strike with some force against the side of the building and fall to the ground. When again placed at the starting point it practically repeated the performance except that this time it bumped into the building several times before falling. The third time it also circled and brushed against the side of the building for about twelve feet and then turned and flew in rather an erratic flight between the laboratory and a nearby building. It zigzagged back and forth until it finally reached a tree where it took refuge among the foliage.

After observing these tests I am of the opinion that the failure of these bats

to take flight readily was not on account of any physical inability but because of an inhibition due to the animal's very poor vision in bright light and also possibly to some confusion produced by being exposed to light. These bats have small eyes that are somewhat deep seated, with rather thick, fleshy lids. Since some of those tested seemed to have more difficulty in taking flight from the concrete than from the grass it would appear that either the cushion formed by the latter helped them to take off better or the darker color of the grass gave less reflection than the lighter colored concrete and thus aided their vision and possibly lessened their confusion.

A desire for possible further observations on the flight habits of these bats led to my obtaining this species for the third time. A few days after making the collection in the house at Summit I was informed that a second building about one hundred yards distant from the large tenement house was also inhabited by bats. This was a low, one-story, frame structure about fifteen feet square. The roof was of corrugated iron with a low ridge and the eaves were not more than ten feet from the ground. This building had been unoccupied for several years. On October 7, 1932, Mr. Jacob, Gabriel Wade and I visited this building to ascertain if such a low structure was inhabited by *Dirias*. A small panel in the gable was removed and this left an aperture large enough for Wade to squirm through and enter the low attic. There were only a comparatively few bats present at this time and only seven specimens were collected. These were all adult males of *Dirias albiventer minor*. Four of these were taken in the attic and three were captured outside as they were escaping from the eaves. Several that eluded us and flew among some nearby trees demonstrated that they could crawl through very small apertures and were able to take flight as soon as they emerged at the eaves of the roof.

While at Summit on this occasion we also visited the tenement house again to view the other colony of this species. The bats were not nearly so numerous in the attic above the bath rooms as on our former visit. We estimated that there were not more than 100, at the most, present at this time. Their behavior, however, differed considerably from what we had noted on the previous occasion. They now appeared to be very wary and seemed to show much more fear. Upon our entering the attic the greater number of them began crawling into hiding places in a way they had not done before. Many of them entered the wide crevices between the hip rafters and the corrugated roof, and other hiding places, from which we were unable to remove them without difficulty. After some time and effort we succeeded in collecting twelve *Dirias*, three males and nine females. It would appear that our first visit had not only caused the members of this colony to fear man but had also driven many of them to seek a new place to roost.

On February 7, 1933, specimens of this species were obtained for the fourth time. These were two adult females that were shot while they were skimming about over the surface of the Chucunaque River in the Darien Province of

Panama. Dr. Paul W. Wilson, Lieut. Commander, U. S. Navy, and Mr. Charles E. Martin, Chief Pharmacist Mate, U. S. Navy, while descending this river in a canoe at dusk on the evening of October 15, 1932, noted a great many bats flying about in a small area above the surface of the water. This was at a point a short distance above the mouth of the Tuquesa River. They were impressed with the number and coloration of these bats and informed me of what they had observed. Later they very kindly made a second visit to this area in order that I might accompany them and, if possible, secure specimens of these bats. After traveling about 35 miles above Yavisa, on the Chucunaque River, in a pirogue driven by an outboard motor, we reached what we considered to be the site of the previous appearance of the bats. Apparently we erred somewhat in the location and ascended the river about a mile too far. Here we waited from early twilight until late dusk without seeing any bats. Soon after we had started to return down the river we encountered a large number of them. They were circling about and flying back and forth over the water and dipping down to the surface apparently to sip water each time they passed in either direction. Although there was but little light remaining the good marksmanship of Mr. Martin resulted in wounding two of the bats and causing them to fall in the water where we were able to capture them. We then noticed a dead, bleached trunk of a tree about sixty feet in height, devoid of all limbs and broken off at the top, standing like a tall white pillar a few yards back from the bank of the river. Two large holes were visible in the side of this trunk and apparently another was at the top. So many bats flying about in so small an area over the river and so near the dead tree led us to suspect that the tree was their roosting place.

The last lot of *Dirias* obtained consisted of 115 specimens collected in the attic of a house at Las Cascadas, Canal Zone. This house was a large, two-story, wooden structure that had been unoccupied for several months. The bats were massed together behind several cross rafters in a corner of the attic near the eaves. There must have been several hundred of them in this corner and we collected them by the handfuls as in the attic at Summit. They were either unafraid of us or so confused by our lights that they did not make many efforts to escape. A few climbed along the rafters and attempted to hide and a number of those nearest the eaves crawled beneath the corrugated roofing and took flight.

The presence of these bats in the attic was readily perceptible, upon our entering it, by the characteristic strong odor. A mass of wet guano beneath the hanging bats had accumulated until it formed a mound more than ten inches deep.

On leaving the house we noticed a number of the bats flying about in circles above an open space in front of the building. They evidently had not sought another hiding place and were not flying higher than the eaves of the house. As we appeared on the ground near them they flew back to the end of

the building and presumably returned to their roosting place in the corner of the attic.

Of the bats collected, 72 were females and 43 were males. All appeared to be adults and it is believed that they consisted of old individuals and younger ones that had only recently matured. Thirty-eight of the females had large, dark colored teats with the appearance of having nursed young. The remainder of the females had teats so small that apparently they had never given birth to young. Sixteen of the females, eight of those believed to be the older individuals and eight of the younger ones, were killed and examined for fetuses but none were found. It is hoped that more extensive observations may result in obtaining more information regarding the breeding habits of this species.

The bats of this lot were of much more sombre colors than those taken at Summit. The dorsal colors varied from dull brown to a lighter and more glossy seal brown. The light, median dorsal stripe was present on practically all of them. Many had a sprinkling of fine silvery white, or brown and silvery white, hairs on the dorsum that gave somewhat of a frosty appearance. One old female was a light tan color on the dorsum and this was the only bright colored one in the lot.

SUMMARY

During a period of less than three years specimens of *Dirias albiventer minor* were obtained from five sources in Panama. Finding them in large numbers in the attics of houses demonstrates that they are not solitary in habits. The presence of a number of them at considerable distance from a human habitation indicates that they are not confined to attics or buildings but may also roost in hollow trees or some other natural situations.

A very strong and offensive odor is given off by this species.

A peculiar formation in the skin of the scrotum of the males was noted.

This species apparently is insectivorous. A diet consisting of various kinds of food supplied to them in captivity seemed unsatisfactory and no individual of this species survived longer than thirty-eight days under laboratory conditions.

Although it was at first considered that this species was unable to take flight from a low elevation this was later found to be an error and the hesitancy in taking wing seems probably due to poor vision in the day and an aversion to light.

REFERENCES

(1) Osgood, W. H. 1910. Mammals from the coast and islands of northern South America. Field Mus. Nat. Hist., Zool. Ser. Publ. 149, vol. 10, no. 4, pp. 30–32.

(2) Osgood, W. H. 1912. Mammals from western Venezuela and eastern Colombia. Field Mus. Nat. Hist. Zool. Ser. Publ. 155, vol. 10, no. 5, pp. 62–63.

(3) GOLDMAN, E. A. 1920. Mammals of Panama. Smithsonian Misc. Coll. vol. 69, no. 5, pp. 177–178.
(4) GOODWIN, G. G. 1928. Observations on Noctilio. Journ. Mamm. vol. 9, no. 2, p. 106.
(5) HOWELL, A. B. 1920. Contribution to the life-history of the California mastiff bat. Journ. Mamm., vol. 1, no. 3, p. 112.

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DEVELOPMENT AND GROWTH OF DEERMICE (PEROMYSCUS MANICULATUS ARTEMISIAE)

BY ARTHUR SVIHLA

With few exceptions (Johnson 1927 and 1931, Selle 1928, and Wade 1927), little is known concerning the growth and development of our native wild mammals, for the majority of studies which have been made in these subjects have dealt with domestic or laboratory animals such as fowls (Latimer 1932), dairy cows (Brody 1927), house rats (Donaldson 1925), mice (Gates 1925), or with man (Scammon 1930). Most of these researches have considered the increase in weights of the animals and their various organs and have usually ignored the relative increases in body measurements.

It is the intention of the author to make a comprehensive study of the growth and development of the various species and subspecies of the deermice of the genus *Peromyscus*. This group of rodents was selected as study material for several reasons, chief among which are the following: they are the most abundant and most widely distributed of all our native North American mammals; they are well known taxonomically (Osgood 1909) and are especially interesting from the point of view of speciation; at least six subgenera and eight species groups with various subspecies occur within the geographic limits of the United States; the subspecies are distinguishable by means of body measurements and hence are particularly suited for growth studies.

A beginning of this study has been made by utilizing the form of deermouse most easily obtained near Pullman, Washington, which is *Peromyscus maniculatus artemisiae*. A stock of this sagebrush-inhabiting deermouse was secured at Palouse Falls, Adams County, Washington, during October, 1931, and bred in captivity. The mice were fed a balanced ration of ground whole wheat, powdered whole milk and iodized salt, in addition to which apples or lettuce trimmings were given twice a week. Water was furnished by means of drop bottles. The mice were examined daily and the young marked at birth. The marking was accomplished by branding various parts of the body with a hot wire. For instance, number one was designated by a brand on the right shoulder; number two on the right side; three, the right hip; four, the left shoulder; five, the left side; six, the left hip; seven, the back. When, about

the fourth week, the hair had grown enough to make the brand indistinct, corresponding patches of hair were cut off with sharp scissors.

Notes on the development of the mice were taken in conjunction with the growth data. At birth the young are pink in color, hairless except for the vibrissae or whiskers, and have both eyes and ears closed. During the first twenty-four hours the dorsal parts of the young mice become pigmented, and by the second day hair appears. The pinnae of the ears are folded down flat over the orifice and in the majority of cases do not unfold until the mice are four days old. The eyes usually opened on the fifteenth day, although this varied from the fourteenth to the nineteenth day in a few cases. The more or less gradual process of weaning was usually completed by the twenty-fifth day.

Weights in grams and measurements in millimeters of a maximum of sixty-three and a minimum of fourteen mice were taken from birth to sixty days of age at two-day intervals. They were still growing slightly at this age (60 days) but in general appearance they were mature. Dice (1932) has shown that deermice continue to grow at a slow rate even after two years of age. The usual measurements of total length, tail length, hind foot and ear from notch were taken by means of a steel rule and vernier calipers. Weights were taken in grams on a laboratory balance sensitive to fifty milligrams. These were all made by the author so that any personal error was maintained as constant. During the first few days after birth, the young mice were so small and squirmy that measuring by hand was extremely difficult. A method was therefore devised (Svihla 1933) whereby each litter was photographed with a Leica camera at one-fourth natural size. The negative was then enlarged forty times by means of a lantern slide projector, the measurements taken with a pair of dividers and these reduced one-tenth. As the mice became older and more active, they were anaesthetised and thus completely relaxed before being weighed and measured. The data concerning the weights and measurements thus obtained were arranged in statistical form and the means with the respective probable errors computed.

At birth the total lengths varied from 38 to 57 mm. with a mean of $45.57 \pm .31$ mm. Growth was most rapid up to about the time of weaning or the 25th day. By this time the mean original length had approximately trebled. The rate then slowed down and by the 60th day the mice had practically attained adult size. The mean at this time was $152.97 \pm .71$ mm. The mean of 13 adults which were the parents of these mice was found to be $171.61 \pm .93$ mm. (Figure 1).

The tail lengths of the newly born mice were relatively constant, varying from 9 to 13 mm. with a mean of $11.30 \pm .08$ mm. The rate of growth of the tails practically paralleled that of the total lengths in that it was rapid at first and then gradually slowed down. During the first 25 days the tails increased in length more rapidly than did the total lengths for the tails were more than

five times their original lengths by this time. At 60 days the mean tail length was 70.83 ± .62 mm., while the mean for the 13 adult parent mice was 82.38 ± .60 mm. (Figure 2).

The lengths of the hind feet varied at birth from 5.8 to 7.3 mm. with a mean of 6.44 ± .35 mm. By the 25th day the mean foot length was 18.75 ±

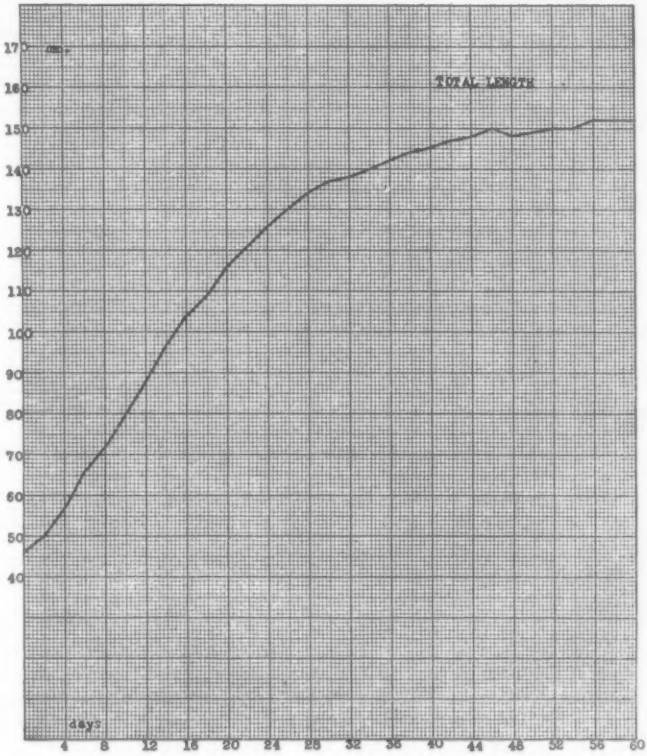

FIG. 1. MEAN TOTAL LENGTH GROWTH CURVE

.71 mm. Thus the original size had trebled and adult length was practically attained. The mean hind foot length for the 13 parent mice was 19.38 ± .63 mm. (Figure 3).

Ear measurements were first taken on the fourth day, at which time most of the pinnae had unfolded. These varied from 3.5 to 5.4. mm. with a mean of 4.49 ± .48 mm. By the 25th day the mean ear length was 14.69 ± .92

mm., only 2 mm. less than adult length, which was 16.87 ± .74 mm., the mean of the 13 parent mice (Figure 4).

At birth these mice varied in weight from 1.3 to 2.2 grams with a mean of 1.80 ± .68 grams. This curve shows the most constant rate of increment, the mice gaining on an average 0.5 grams a day. By the 25th day the mean weight had increased 6 times. At 60 days of age the mice had attained a mean weight of 17.83 ± .3.11 grams, or approximately 4 grams less than the mean weight of the 13 parent mice, which was 21.28 ± .87 grams (Figure 5).

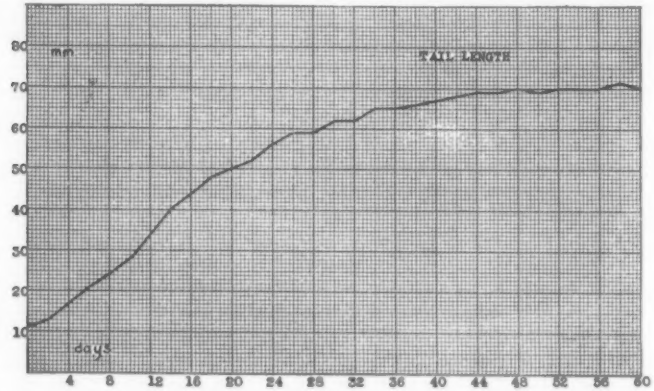

FIG. 2. MEAN TAIL LENGTH GROWTH CURVE

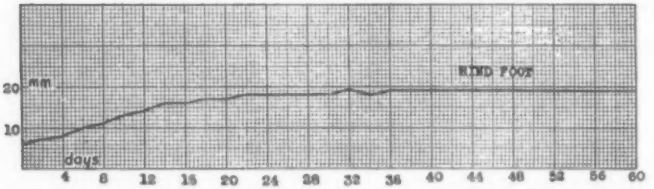

FIG. 3. MEAN HIND FOOT GROWTH CURVE

A rapid increase is indicated at the beginning of all these curves and then a more or less gradual slowing down in rate. The various parts, however, did not increase at the same rate. By the time of weaning or the 25th day, the mean total length had trebled, the tail length had increased more than five times, the hind foot had trebled, and the ear had increased almost four times. The two latter features had attained almost adult size at this time. The mean weight showed the most gradual increase and was 6 times the original weight by the time of weaning. At 60 days of age the total lengths and tail lengths

of these mice were still increasing, although at a greatly reduced rate. The hind feet and ears reached adult size relatively early in the lives of these mice.

There is a more or less perceptible slowing down in rate of increase in the body measurements and weights after the time of weaning. It has been shown in a previous work (Svihla 1932) that the gestation period for non-lactating females of this subspecies is normally 23 days. When a litter of young is nursed during pregnancy, this period is prolonged to an average of 25 days. It was also found that when the second litter is born, the mother will have nothing more to do with the young of the first litter so that they are forcibly weaned and made to shift for themselves. At this time their diet changes so that it is composed almost entirely of solid foods and their activity is greatly

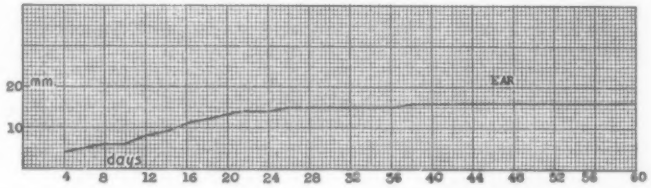

FIG. 4. MEAN EAR FROM NOTCH GROWTH CURVE

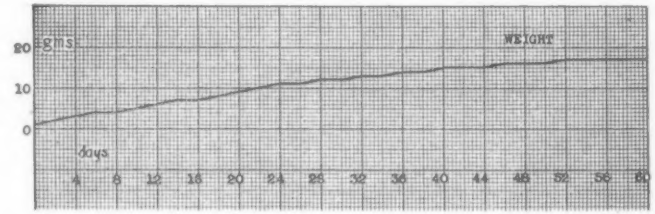

FIG. 5. MEAN WEIGHT GROWTH CURVE

increased since they must now forage for themselves. These changes may necessitate metabolic adjustments which may be influential in slowing down the rate of growth.

Johnson (1931) computed a weight curve for young thirteen-lined ground squirrels which showed a stopping of growth after the eyes opened and the ground squirrels were weaned; then a decided increase in rate. The former he explains as due to failure to get enough milk from the mother and the latter as probably due to an increasing ability to assimilate their food. The weight curve showed a dish-shaped appearance quite different from the weight curve of the deermice.

SUMMARY

At birth deermice, *Peromyscus maniculatus artemisiae*, are hairless, blind, and pink in color. Within twenty-four hours, the backs become pigmented, and by the second day hair appears. The pinnae of the ears which are folded over at birth usually unfold by the fourth day. The eyes open on or about the fifteenth day. Within twenty-five days the young mice are weaned, at which time a second litter is usually born.

Various parts of the body do not grow at the same rate. By the twenty-fifth day, which is the approximate time of weaning, the total length has trebled; the tail length has increased five times; the hind foot has trebled; the ear has more than trebled; and the weight has increased about six times. By the sixtieth day the total length, the tail length, and the weight are all still increasing, although at a slow rate, not having quite reached adult proportions. The hind feet and the ear, almost adult in size by the time of weaning, have become fully grown by the thirty-second and thirty-eighth day respectively. All the curves show a greater increase in rate during the first twenty-five days than later. This may be interpreted as being due to the fact that after weaning the metabolic readjustments probably necessitate a slowing down of the growth rate.

LITERATURE CITED

Brody, S. 1927. Growth and development with special reference to domestic animals. Research Bull., Missouri Agric. Exp. Sta., vol. 97, pp. 1–70.

Dice, L. R. 1932. Variation in a geographic race of the deermouse, *Peromyscus maniculatus bairdii*. Occas. Papers. Mus. Zool., Univ. Michigan, vol. 239, pp. 1–26.

Donaldson, H. H. 1924. The rat. Data and reference tables for the albino rat (*Mus norvegicus albinus*) and Norway rat (*Mus norvegicus*). 2nd edit. Mem. Wistar Inst., pt. 6, Philadelphia.

Gates, W. H. 1925. Litter size, birth weight, and early growth rate of mice (*Mus musculus*). Anat. Rec., vol. 29, pp.183–193.

Johnson, G. E. 1927. Observations on young prairie-dogs (*Cynomys ludovicianus*) born in the laboratory. Journ. Mamm., vol., 8, pp. 110–115.

———— 1931. Early life of the thirteen-lined ground squirrel. Trans. Kansas Acad. Sci., vol. 34, pp. 282–290.

Latimer, H. B. 1932. Postnatal growth changes in the single comb white leghorn chicken. Univ. Kansas Bull., no. 33, pp. 199–206.

Osgood, W. H. 1909. Revision of the mice of the American genus *Peromyscus*. North Amer. Fauna, no. 28, pp. 1–285.

Scammon, R. E. 1930. The measurement of the body in childhood. The measurement of man. Univ. of Minnesota Press, pp. 173–214.

Selle, R. 1928. *Microtus californicus* in captivity. Journ. Mamm., vol. 9, pp. 93–98.

Svihla, A. 1932. A comparative life history study of the mice of the genus *Peromyscus*. Misc. Publ. Mus. Zool., Univ. Mich. no. 24, pp. 1–39.

———— 1933. An accurate method for measuring new-born mice. Science, n.s., vol. 77, p. 331, March 31.

Wade, O. 1927. Breeding habits and early life of the thirteen-lined ground squirrel *Citellus tridecemlineatus* (Mitchill). Journ. Mamm., vol. 8, pp. 269–276.

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POCKET GOPHERS OF THE GENUS THOMOMYS OF MEXICAN MAINLAND AND BORDERING TERRITORY

By E. W. Nelson and E. A. Goldman

Bailey, in revising the pocket gophers of the genus *Thomomys* (North Amer. Fauna, No. 39, pp. 89–96, Nov. 15, 1915), was very conservative in his treatment of the *Thomomys umbrinus* group. This section of the genus ranges from near timberline on the volcanoes about the southern end of the Mexican tableland and the tropical coastal lowlands of Nayarit northward along the Sierra Madre and over the tableland to southern Arizona and New Mexico. The acquisition of additional material and our familiarity with the territory covered afford us a clearer concept of group alignments and enable us to correlate differential characters with diverse environmental conditions. The distribution of the pocket gophers of the genus *Thomomys* in Mexico is irregular. In places it is discontinuous owing to physical barriers or to the intrusion of colonies of pocket gophers of other genera, or to local disappearance resulting from a variety of causes. In southern Mexico this genus extends well into a transcontinental belt which includes the highest mountains of the continent south of Alaska. In this region there occur widely diversified ecological conditions, from arid tropical lowlands and exuberant rain forests up through oaks and conifers to timberline. In this comparatively limited but wonderfully varied region has come about an extraordinary development of the family *Geomyidae*. The distribution areas of the various genera are intricately interwoven. Different genera or species often occur in close proximity on the same high mountains, or on the plains; but, apparently, two forms never occupy one local terrain. The strict local segregation of each species of gopher in definite territory apart from any other member of the family is difficult to account for unless it is the result of the fierce pugnacity shown by these animals toward one another, a pugnacity that is probably especially violent between different species. On the Volcano of Popocatepetl the range of a *Thomomys* near timberline at 13,000 feet seems to be interrupted at 11,500 feet by that of *Cratogeomys oreocetes*. We found the north slope of the Volcano of Toluca at 9,500 feet inhabited by an allied subspecies of *Thomomys* while at 8,600 feet on the same slope of the same mountain we collected *Platygeomys planiceps*. On the plains at San Martin Texmelucan, Puebla, we were surprised to find *Thomomys*, in view of the fact that similar territory is occupied by *Cratogeomys merriami* not far to the north and by *C. fulvescens* to the east.

The *Thomomys umbrinus* and *T. bottae* groups, here treated as distinct, are normally recognizable by the differing number of pectoral mammae (one pair in *umbrinus*, two pairs in *bottae*) and in the summation of cranial details, none of which is very trenchant. These two groups overlap in general geographic range in the region near the Mexican boundary line. Colonies of the two occurring near together appear to be quite distinct, but general resemblances

are so close that individual variation tends to mask the characters. As a result some individuals from localities in southern Arizona are difficult to place with certainty.

Our studies appear to justify the reduction of several nominal species to subspecific rank and also to justify the description of 25 previously unrecognized forms. Several subspecies currently assigned to the so-called *Thomomys perpallidus* and *Thomomys fulvus* groups are here transferred to the *Thomomys bottae* group, now known to range eastward from California to Texas.

In describing color, Ridgway's "Color Standards and Color Nomenclature," 1912, has been utilized, supplemented by other terms which seem more accurate and applicable to some of the blended tones and details. Specimens examined, unless otherwise indicated, are in the U. S. National Museum.

For the loan of specimens for comparison we are indebted to Dr. Thomas Barbour and Dr. Glover M. Allen, Museum of Comparative Zoology, and to H. E. Anthony and George G. Goodwin, American Museum of Natural History.

Thomomys umbrinus Group

Thomomys umbrinus (Richardson)

[References under subspecies]

Distribution.—Mexican tableland region from Valley of Mexico north to southeastern Arizona, southwestern New Mexico and western Texas, and Pacific coastal plains from southern Nayarit north to southern Sonora.

Thomomys umbrinus umbrinus (Richardson)

Geomys umbrinus Richardson, Fauna Boreali-Americana, vol. 1, p. 202, 1829. Type said to have come from "Cadadaguios, a town in southwestern Louisiana," a locality that cannot now be identified.

Thomomys umbrinus Bailey, Proc. Biol. Soc. Washington, vol. 19, p. 3, Jan. 29, 1906. Name restricted to the race occurring at Boca del Monte, Vera Cruz, Mexico.

Thomomys umbrinus umbrinus Bailey, North Amer. Fauna, No. 39, p. 89, Nov. 15, 1915.

Distribution.—Eastern edge of high plateau at Boca del Monte, eastern Vera Cruz; limits of range unknown.

Thomomys umbrinus orizabae Merriam

Thomomys orizabae Merriam, Proc. Biol. Soc. Washington, vol. 8, p. 145, Dec. 29, 1893. Type from Mount Orizaba (altitude 9,500 feet).

Thomomys umbrinus orizabae Bailey, North Amer. Fauna, No. 39, p. 90, Nov. 15, 1915.

Distribution.—Known only from the upper slopes of Mount Orizaba.

Thomomys umbrinus albigularis, subsp. nov.

Type.—From El Chico, Sierra de Pachuca, Hidalgo, Mexico (altitude 9,800 feet). No. 51888, ♀ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, March 27, 1896. Original number 4505.

Distribution.—Sierra de Pachuca, eastern Hidalgo, Mexico.

TABLE 1

Cranial measurements of type specimens (all measurements in millimeters)

NAME	LOCALITY	NUMBER (U.S.N.M.)	SEX	GREATEST LENGTH	OCCIPITONASAL LENGTH	ZYGOMATIC BREADTH	WIDTH ACROSS SQUAMOSALS (OVER MASTOIDS)	INTERORBITAL CONSTRICTION	LENGTH OF NASALS	MAXILLARY TOOTH-ROW (ALVEOLI)
Thomomys umbrinus albigularis	El Chico, Hidalgo	51888	♀	35	34	23	18.4	6.9	11.7	6.9
Thomomys umbrinus martinensis	San Martin Texmelucan, Puebla	55622	♀	35.4	33.2	23.9	17.9	6.7	10.8	7.1
Thomomys umbrinus toluca	Volcano of Toluca, Mexico	55908	♂	43	40.7	26.9	20.4	6.9	13.9	7.9
Thomomys umbrinus vulcanius	Volcano of Popocatepetl, Mexico	51885	♀	37.2	35.9	23.7	19.1	6.9	11.3	7.5
Thomomys umbrinus supernus	Santa Rosa, Guanajuato	81687	♂	37	35.8	24	19	6.4	12	7.6
Thomomys umbrinus potosinus	La Tinaja, San Luis Potosi	82057	♂	36	34.3	23.5	18.5	6.1	11.6	7.5
Thomomys umbrinus zacatecae	Berriozabal, Zacatecas	57972	♂	40.2	38	25.5	19.8	6.4	12.8	7.8
Thomomys umbrinus enixus	Sierra Moroni, Zacatecas	90834	♂	36.4	34.8	23.3	18.8	6.4	11.7	7.4
Thomomys umbrinus crassidens	Sierra de Valparaiso, Zacatecas	91986	♂	40.2	39.3	27.3	21.4	7.3	14.2	8.5
Thomomys umbrinus chihuahuae	Sierra Madre, Chihuahua	96452	♂	39.3	39.3	25.3	19.2	7	14.5	7.8
Thomomys umbrinus durangi	Durango, Durango	94603	♂	35.7	34.2	23.5	17.8	6.2	11	6.8
Thomomys umbrinus evexus	Mount San Gabriel, Durango	21208*	♀	35	33.2	21.5	17.8	6.2	10.3	7.2
Thomomys umbrinus madrensis	Colonia Garcia, Chihuahua	98203	♂	39.5	39	24.8	19.1	6.3	15	7.8
Thomomys umbrinus caliginosus	Altamirano, Chihuahua	250887	♂	35	35	21.7	18.1	6.8	12.5	6.4
Thomomys umbrinus chiricahuae	Chiricahua Mountains, Arizona	247828	♂	37.5	37.5	21.9	18.2	6.5	13.5	8.2
Thomomys umbrinus sonoriensis	Chinapa, Sonora	250893	♀	38	37.2	23.4	19.1	7.4	11.8	7.8
Thomomys umbrinus eximius	Sierra de Choix, Sinaloa	96458	♂	35	34.4	22.4	17.7	6.9	12.2	7.5
Thomomys umbrinus musculus	Pedro Pablo, Nayarit	90918	♂	36.6	34.5	22.7	17.9	6.6	11.2	6.8
Thomomys umbrinus extimus	Colomo, Nayarit	88131	♂	42	40	27.3	20.6	7	13.7	8.3
Thomomys simulus simulus	Alamos, Sonora	96463	♂	34.9	34.2	21.5	17.4	6.3	11.3	7.2
Thomomys simulus parviceps	Chacala, Durango	96743	♀	31.7	30.8	29.1	15.4	6.8	10	6.3
Thomomys bottae winthropi	Hermosillo, Sonora	251028	♂	46.3	44.7	29.4	23.8	6.9	16.4	9.4
Thomomys bottae divergens	Huachinera, Sonora	250892	♂	43.5	42.8	26.3	21.7	6.7	15.6	9.1
Thomomys bottae convergens	Costa Rica Ranch, Sonora	250894	♂	43.8	41.2	26.7	22.1	7.5	14.2	8.2

* A. M. N. H.

General characters.—A large subspecies similar to *T. u. orizabae*, but color paler; throat and median line of chest with conspicuous white markings and skull differing in detail. Differing from *T. u. umbrinus* and *T. u. peregrinus* in larger average size, lighter color and cranial combination.

Color.—Type: Upper parts between cinnamon and mikado brown, slightly darkened over top of head and back by black-tipped hairs, becoming lighter and passing gradually into ochraceous buff along sides, forearms and thighs; under parts overlaid with ochraceous buff except on throat and cheeks where the hairs are pure white to roots; ears and post-auricular spots black, as usual in the group; feet whitish; tail brownish above near base and ochraceous buffy below, becoming dull whitish all around toward tip.

Skull.—Closely resembling that of *orizabae*, but rostrum narrower; braincase usually broader; zygomata usually more widely spreading; maxillary toothrows shorter. Differing from that of *umbrinus* in larger average size and relatively shorter maxillary toothrows; frontal region slightly depressed anteriorly along line of contact with nasals as in *umbrinus*. Compared with that of *peregrinus* the skull is usually larger and broader, with maxillary toothrows of similar length.

Measurements.—Type: Total length, 205 mm.; tail vertebrae, 63; hind foot, 26. An adult male from Real del Monte: 230; 76; 29. *Skull:* (see table p. 107).

Remarks.—Thomomys umbrinus albigularis requires closer comparison with *orizabae* than with any of the other nearly related forms, but it is readily distinguished by the characters pointed out. None of the specimens are in the black phase shown in 15 of the 17 topotypes of *orizabae* examined.

Specimens examined.—Total number, 6, all from Hidalgo, as follows: El Chico, Sierra de Pachuca (type locality), 2; Real del Monte, 3; Tulancingo, 1.

Thomomys umbrinus peregrinus Merriam

Thomomys peregrinus Merriam, Proc. Biol. Soc. Washington, vol. 8, p. 146, Dec. 29, 1893. Type from Salazar, Mexico, Mexico (altitude 10,300 feet).

Thomomys umbrinus peregrinus Bailey, North Amer. Fauna, No. 39, p. 91, Nov. 15, 1915.

Distribution.—Upper slopes of the Sierra de las Cruces, between the Valley of Mexico and the Valley of Toluca, and neighboring parts of the latter valley.

Thomomys umbrinus martinensis, subsp. nov.

Type.—From San Martin Texmelucan, Puebla, Mexico (altitude 7,400 feet). No. 55622, ♀ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, August 13, 1893. Original number 5305.

Distribution.—Elevated plains and lower slopes of hills in the vicinity of the type locality, western Puebla.

General characters.—Similar to *T. u. umbrinus*, but color richer, more cinnamon, and cranial details, especially the much smaller bullae, distinctive; pectoral mammae one pair, as in *umbrinus*. Somewhat similar to *T. u. peregrinus*, but color lighter above and below; basal color of under parts paler plumbeous; skull differing notably in more widely and squarely spreading zygomata.

Color.—Type (acquiring fresh pelage): Upper parts near cinnamon, purest along sides, mixed with black on head and along middle of back, the black predominating on top of head; outer sides of forearms pinkish buff; under parts lightly overlaid with pale pinkish buff; muzzle blackish; small area on middle of chin white; fore feet brownish to toes, which are white; hind feet whitish except proximal half of metatarsus which is brownish like ankles; tail light brownish, slightly paler below.

Skull.—Most closely resembling that of *T. u. umbrinus*, but zygomata more squarely

spreading, the sides less bowed outward, slightly compressed laterally or bent inward near middle; maxillary arm of zygoma heavier; squamosal shelf less projecting over auditory meatus; bullae smaller, less inflated; lacrimal articulating mainly with maxilla as in *umbrinus*. Compared with that of *peregrinus* the skull is broader, less elongated; zygomata heavier and more widely and squarely spreading; rostrum broader; bullae smaller.

Measurements.—Type: Total length, 180; tail vertebrae, 56; hind foot, 25. An adult female topotype: 196; 68; 30. *Skull:* see table, p. 107.

Remarks.—T. u. martinensis appears to be more closely allied to typical *umbrinus* than to any of the other described forms. Neighboring territory of similar character to the north is inhabited by the much larger pocket gopher *Cratogeomys merriami* and to the east by *C. fulvescens*. Whether or not the range of *martinensis* is confluent with that of other closely related forms remains to be determined.

Specimens examined.—Two, from the type locality.

Thomomys umbrinus tolucae, subsp. nov.

Type.—From Volcano of Toluca, Mexico, Mexico (north slope, altitude 9,500 feet). No. 55908, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, September 5, 1893. Original number 5385.

Distribution.—Known only from the upper slopes of the Volcano of Toluca.

General characters.—A large, dark-colored subspecies, closely allied to *Thomomys umbrinus peregrinus*, but larger; color about the same above; lips grayish brown instead of black; white spots on chin and throat (when present) usually larger; skull differing in detail. Similar in size to *T. u. orizabae* but darker in normal color phase, and cranial features distinctive. Differing from *T. u. umbrinus* in larger size and richer, more rufescent coloration.

Color.—Type: Upper parts between russet and mars brown, heavily mixed with black, becoming lighter russet along sides and on legs; under parts in general overlaid with light russet, the basal color deep plumbeous; lips grayish brown; a white spot on middle of throat; feet whitish; tail grayish brown mottled with white on basal half, becoming whitish all around on terminal portion.

Skull.—Closely resembling that of *orizabae* but braincase usually broader and zygomata more widely spreading; molariform teeth slightly smaller. Skull similar to the skulls of *umbrinus* and *peregrinus* but decidedly larger.

Measurements.—Type: Total length, 246 mm.; tail vertebrae, 82; hind foot, 32. An adult male topotype; 205; 71; 30. Average of four adult female topotypes; 212 (208–220); 68 (63–78); 29 (28–31). *Skull:* see table, p. 107.

Remarks.—Thomomys umbrinus tolucae is closely allied to its geographic neighbors but the combination of color and slight cranial features is distinctive. It has a range apparently restricted to high elevations on the Volcano of Toluca. At 9,000 feet on the same slope of the Volcano of Toluca *Platygeomys planiceps* was found, and colonies of this larger animal may be barriers to the extension of the *Thomomys* to lower levels.

Specimens examined.—Total number, 15, all from the type locality.

Thomomys umbrinus vulcanius, subsp. nov.

Type.—From the Volcano of Popocatepetl, Mexico, Mexico (altitude 12,900 feet). No. 51885, ♀ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, February 27, 1893. Original number 4407.

Distribution.—Known only from near timberline on the Volcano of Popocatepetl.

General characters.—Similar in size to *T. u. tolucae*; general color duller, more uniform, the sides less contrasting with back; skull differing in detail. Color about as in *T. u.*

umbrinus but size larger, and cranial characters quite distinctive. Differing from *T. u. peregrinus* in duller, more uniform coloration and larger skull.

Color.—Type: (fresh pelage): Upper parts in general near verona brown (Ridgway, 1912), heavily mixed with black, the black predominating on top of head and median dorsal area; lower part of sides and outer surfaces of forearms lighter and tinged with cinnamon; under parts thinly overlaid with light cinnamon; muzzle black, except lips and middle of chin which are white; fore feet brownish to toes which are white; hind feet whitish with dusky of ankles extending about halfway over middle of metatarsus; tail brownish above, slightly paler below to near tip which is white.

Skull.—Very similar to that of *tolucae*, but rostrum and nasals shorter; zygomata narrower; pterygoids broader and heavier, as viewed from below; molariform teeth slightly larger. Decidedly larger, more massive throughout than that of *peregrinus*. Compared with that of *umbrinus* the skull is larger, more massive; braincase broader; rostrum heavier, less depressed anteriorly; interorbital region broader; zygomata narrower, less bowed outward, the sides more nearly parallel; pterygoids and palatine shelves broader; upper incisors more abruptly decurved.

Measurements.—Type: Total length, 206; tail vertebrae, 66; hind foot, 31. *Skull:* see table, p. 107.

Remarks.—T. u. vulcanius is based on a single specimen presenting features that appear to indicate subspecific distinctness. It agrees more closely in general characters with *tolucae* than with any other known form. The high mountain ranges of the two appear to be separated, however, by the comparatively low pass west of the Volcano of Popocatepetl. The occurrence of *Cratogeomys oreocetes* at 11,000 feet on the same mountain may be a further bar to the more extended distribution of *vulcanius*.

Thomomys umbrinus supernus, subsp. nov.

Type.—From Santa Rosa, about 7 miles northeast of Guanajuato, Guanajuato, Mexico (altitude between 9,500 and 10,000 feet). No. 81687, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, November 15, 1896. Original number 10353.

Distribution.—High mountains of central Guanajuato.

General characters.—Closely allied to *T. u. albigularis*, color similar but size decidedly smaller. Not very unlike *T. u. tolucae* in general, but usually lighter in color, the throat especially more extensively white, and size much smaller.

Color.—Upper parts near mikado brown, heavily mixed with black from top of head to middle of back, passing into cinnamon on rump, sides, forearms, and thighs; under parts overlaid with cinnamon, the under color dark plumbeous except on chin and throat were the hairs are pure white to roots; ears encircled by deep black areas; sides of muzzle blackish; cheek pouches lined with white; feet whitish; tail brownish basally above and below, becoming white all around toward tip. Topotypes vary from a black phase including black under parts with white throat to individuals that are near cinnamon above and ochraceous buffy below.

Skull.—Similar to those of *albigularis* and *tolucae*, but much smaller.

Measurements.—Type: Total length, 200 mm.; tail vertebrae, 57; hind foot, 29. An adult male topotype: 185; 52; 27. Average of four adult female topotypes: 184 (180–187); 56 (48–61); 27 (26–27). *Skull:* see table, p. 107.

Remarks.—T. u. supernus is one of the several forms with ranges restricted to high mountain areas of limited extent. It is readily distinguished from any of its geographic neighbors.

Specimens examined.—Nine, all from the type locality.

Thomomys umbrinus potosinus, subsp. nov.

Type.—From La Tinaja, about 20 miles northeast of San Luis Potosi, Mexico (altitude 6,000 feet). No. 82057, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, January 22, 1897. Original number 10469.

Distribution.—Open plains of southwestern San Luis Potosi.

General characters.—A small subspecies, allied to *T. u. supernus*; basal color on under parts lighter plumbeous; lower lip dusky instead of white; chin and throat without the conspicuous pure white area present in *supernus*; skull about the same. Similar in size to *goldmani*, but color darker, the upper parts more heavily mixed with black and under parts and forearms buffy instead of whitish; skull heavier.

Color.—Type: Upper parts near mikado brown, moderately mixed with black over top of head and dorsum, becoming pinkish buff on sides, forearms, and thighs; under parts overlaid with pinkish buff, the under color light plumbeous; muzzle black all around; cheek pouches lined with white; feet whitish; tail nearly unicolor, thinly clothed with grayish hairs. Upper parts varying in tone in other specimens to near light tawny.

Skull.—About as in *supernus*. General size and form about as in *goldmani*, but of heavier proportions; rostrum broader; zygomata heavier; incisors decidedly broader.

Measurements.—Type: Total length, 207 mm.; tail vertebrae, 65; hind foot, 27. An adult male topotype: 194; 58; 26. Five adult female topotypes: 185 (173–195); 56 (51–62); 25 (25–26.5). *Skull:* see table, p. 107.

Remarks.—Close relationship of the present form from the plains of San Luis Potosi to *T. u. supernus* of the high mountains of Guanajuato is shown by agreement in cranial features; but the differences in general color, and in the color of the lower lip, chin, and throat in nearly all specimens are quite distinctive.

Specimens examined.—Eight, all from the type locality.

Thomomys umbrinus atrodorsalis, subsp. nov.

Type.—From Alvarez, San Luis Potosi, Mexico (altitude 8,000 feet), No. 20487, ♂ adult, skin and skull, Museum of Comparative Zoology, collected by W. W. Brown, November 7, 1923. Original number 338.

Distribution.—Known only from the type locality near the city of San Luis Potosi.

General characters.—A small subspecies characterized by blackish and buffy color phases; in about one-half of the specimens black strongly predominates over dorsum giving way abruptly to pinkish buff along sides. Very similar in color to *T. u. potosinus* of the open plains to the eastward, in buffy phase, but throat, chest and fore limbs usually deeper buff, less whitish; contrasting strongly in blackish phase; skull differing in detail. Similar in color to *T. u. supernus* of the mountains of central Guanajuato, in buffy phase, but chin and throat buffy instead of white; contrasting strongly in blackish phase with corresponding phase of *supernus*, the black dorsal area interrupted more abruptly along sides and under parts much lighter; skull about the same.

Color.—Type (blackish phase): Upper parts, including face, top and sides of head black, finely and inconspicuously mixed with cinnamon along sides of posterior part of back; underparts overlaid with pinkish buff; a sharp lateral line separating upper and under parts; forearms and thighs like under parts; feet whitish; tail mottled brown and white above on basal two-thirds, white below and toward tip all around. Topotypes in buffy phase: Upper parts cinnamon buff, more or less mixed with black on median dorsal area; under parts overlaid with pinkish buff, this tone extending upward along sides and including forearms and thighs.

Skull.—About as in *supernus*. Very similar to *potosinus*, but usually larger, with longer nasals and slightly smaller auditory bullae.

Measurements.—Type: Total length, 200 mm.; tail vertebrae, 60; hind foot, 27. Average of ten adult male topotypes: 199 (180–220); 63 (55–70); 25.7 (25–28). Average of ten adult female topotypes: 195 (165–205); 60 (52–65); 25.4 (23–27). *Skull* (type): Greatest length, 38; occipitonasal length, 36.6; zygomatic breadth, 24.5; greatest breadth across squamosals (over mastoids), 18.8; interorbital constriction, 5.6; length of nasals, 12.9; maxillary toothrow (alveoli), 7.9.

Remarks.—Selected specimens of *T. u. atrodorsalis* in the buffy phase agree closely with *potosinus*, but are usually less whitish or grayish on the chest and forearms. The subspecies is readily distinguished in the blackish phase by nearly pure black tending to extend like a mantle over entire upper parts and down to a sharp line of demarcation along sides of body.

Specimens examined.—Total number, 58, all from the vicinity of the type locality, as follows: Alvarez, 56 (Mus. Comp. Zool.); San Luis Potosi, 2 (Mus. Comp. Zool.).

Thomomys umbrinus zacatecae, subsp. nov.

Type.—From Berriozabel, Zacatecas, Mexico (altitude 6,600 feet). No. 57972, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, December 29, 1893. Original number 5607.

Distribution.—High arid plains of southeastern Zacatecas.

General characters.—Closely allied to *T. u. potosinus*, but decidedly larger; color paler, and usually duller, the upper parts less heavily mixed with black. Similar to *goldmani* in color, but darker, the forearms buffy instead of white, and size much larger.

Color.—Type: Upper parts near cinnamon, thinly mixed with black over top of head and back, becoming light ochraceous buff on sides, forearms, and thighs; under parts overlaid with light ochraceous buff, the basal color light plumbeous; cheek pouches lined with white; feet white; tail nearly unicolor, thinly clothed with grayish hairs.

Skull.—Similar to that of *potosinus*, but larger, more angular. Compared with that of *goldmani* the skull contrasts strongly in larger size and greater angularity.

Measurements.—Type: Total length, 218 mm.; tail vertebrae, 62; hind foot, 29. Average of three male topotypes: 207 (195–213); 66 (56–73); 30 (28–30). Average of four adult female topotypes: 193 (190–200); 59 (57–62); 27 (26–28). *Skull:* see table, p. 107.

Remarks.—In *T. u. zacatecae* rather large size is combined with light coloration.

Specimens examined.—Ten, all from the type locality.

Thomomys umbrinus enixus, subsp. nov.

Type.—From Sierra Moroni, near Plateado, Zacatecas, Mexico (altitude 8,500 feet). No. 90834, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, September 2, 1897. Original number 11606.

Distribution.—Upper slopes of Sierra Moroni, southern Zacatecas.

General characters.—Closely allied to *T. u. zacatecae*, but color darker and richer, more tawny above and below; skull differing in detail. Similar in general to *T. u. sheldoni*, but upper parts much less heavily mixed with black and skull smaller, less massive.

Color.—Upper parts near tawny (Ridgway, 1912), purest along sides and including outer sides of forearms and thighs, rather thinly mixed with black on top of head and over back; under parts overlaid with rich cinnamon; muzzle blackish; feet and tail whitish.

Skull.—Closely resembling that of *zacatecae*, but rostrum more constricted across base, the lateral margins of maxillae more upturned; braincase rather low and flattened above; maxillary root of zygoma weakly developed, the inner border concave along line of con-

tact with frontal and premaxillae as in other southern members of the group. Compared with that of *sheldoni* the skull is very similar in general form, but decidedly smaller, and of slenderer proportions; interorbital region relatively narrower; maxillary root of zygoma less strongly developed, the inner border concave (convex in *sheldoni*) as viewed from above.

Measurements.—Type: Total length, 195; tail vertebrae, 60; hind foot, 28. An adult female topotype; 205; 65; 27.5. Skull: see table, p. 107.

Remarks.—T. u. enixus is a richly colored, high mountain form, apparently more closely allied to *zacatecae* of the neighboring plains than to any of the other subspecies. A specimen from 7,600 feet near the base of the Sierra Moroni near Plateado is paler, approaching *zacatecae* in color, but in cranial characters is nearer the present form.

Specimens examined.—Four, all from the vicinity of the type locality.

Thomomys umbrinus crassidens, subsp. nov.

Type.—From Sierra de Valparaiso, western Zacatecas, Mexico (altitude 8,700 feet). No. 91986, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, November 30, 1897. Original number 11793.

Distribution.—Known only from the upper slopes of the Sierra de Valparaiso, Zacatecas.

General characters.—A large, richly colored subspecies. Similar to *T. u. sheldoni*, but lighter, more tawny in color, and skull more massive. Not very unlike *zacatecae* of the neighboring plains region, but larger, and decidedly darker and richer in color; skull larger and heavier. Similar to *enixus*, but more tawny, and skull differing in detail.

Color.—Type: Upper parts near tawny, heavily mixed with black which is predominant on head and median dorsal area, becoming lighter tawny on sides, outer surfaces of forearms and thighs; under parts in general overlaid with ochraceous tawny, the basal color deep plumbeous; muzzle, chin and throat blackish; feet whitish; tail nearly unicolor, thinly haired, brownish on basal two-thirds, becoming dull whitish toward tip. A breeding female topotype is melanistic, the general color near slate black above, slightly paler below, except feet and end of tail, which are white as in normally colored individuals.

Skull.—Similar to that of *sheldoni*, but more massive; braincase broader; audital bullae larger, more fully inflated; incisors broader and heavier. Differing from that of *zacatecae* mainly in larger general size and relatively broader rostrum and upper incisors. Compared with that of *enixus* the skull is less massive, with more slender rostrum, weakly developed maxillary roots of zygomata, and narrower upper incisors.

Measurements.—Type: Total length, 211; tail vertebrae, 58; hind foot, 31. Two adult male topotypes, respectively: Total length, 220, 217; tail vertebrae, 70, 67; hind foot, 28.5, 30. Average of four adult female topotypes: 193 (183–205); 60 (56–62); 29 (28–29.5). *Skull:* see table, p. 107.

Remarks.—T. u. crassidens is closely allied to *sheldoni*, and its distinctive characters are doubtless due to isolation on the upper slopes of the Sierra de Valparaiso, an outlying range detached from the main backbone of the Sierra Madre inhabited by the latter form. The rich tawny coloration is unusual in Mexican pocket gophers.

Specimens examined.—Ten, all from the type locality.

Thomomys umbrinus sheldoni Bailey

Thomomys sheldoni Bailey, North Amer. Fauna, No. 39, p. 93, Nov. 15, 1915. Type from Santa Teresa, Sierra del Nayarit, Nayarit, Mexico (altitude 6,800 feet).

Distribution.—Upper slopes of Sierra Madre from northern Nayarit and extreme western Zacatecas north through western Durango to southwestern Chihuahua.

Thomomys umbrinus chihuahuae, subsp. nov.

Type.—From Sierra Madre, about 65 miles east of Batopilas, Chihuahua, Mexico (altitude 7,000 feet). No. 96452, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by E. A. Goldman, October 1, 1898. Original number 13076.

Distribution.—Sierra Madre in southwestern Chihuahua.

General characters.—Similar in size to *T. u. sheldoni*, but much paler and duller colored; upper parts less heavily mixed with black and under parts overlaid with cinnamon buff instead of tawny; cranial characters, especially the more recurved incisors, distinctive; pectoral mammae one pair as usual in the group. Somewhat similar to *zacatecae*, but larger and decidedly darker; skull differing in detail. Approaching *nelsoni* in color, but less refuscent, slightly darker above, and skull quite different.

Color.—Type: Upper parts near cinnamon, purest along sides, moderately mixed with black on head and over back; outer sides of forearms and thighs like sides; under parts overlaid with pale cinnamon buff; muzzle blackish; feet light brownish to toes which are white; tail light brownish above, grayish below.

Skull.—Size about as in *sheldoni*, but zygomata less squarely spreading, narrower posteriorly; interorbital region narrower; upper incisors more strongly recurved. Similar to that of *zacatecae*, but larger; braincase relatively narrower; zygomata narrower posteriorly, the sides less nearly parallel; incisors broader, more recurved. Similar in size to that of *nelsoni*, but braincase narrower; zygomata more evenly bowed outward, narrower posteriorly, the sides less nearly parallel; rostrum broader; nasals longer, more projecting anteriorly beyond premaxillae; upper incisors broader, more recurved.

Measurements.—Type: Total length, 224; tail vertebrae, 72; hind foot, 31. An adult female topotype: 217; 67; 30. *Skull:* see table, p. 107.

Remarks.—*T. u. chihuahuae* inhabits a rather arid, high plateau area somewhat isolated by deep river canyons that transect this part of the Sierra Madre.

Specimens examined.—Five, all from the type locality.

Thomomys umbrinus durangi, subsp. nov.

Type.—From Durango, Durango, Mexico. No. 94603, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, June 28, 1898. Original number 12656.

Distribution.—High plains along the eastern base of the Sierra Madre in southern Durango.

General characters.—A small subspecies with weakly developed skull. Most closely allied to *goldmani*, but darker above; entire forearms, lower part of sides and under parts pale buff instead of white; cranial characters distinctive. Similar to *zacatecae* in color, but much smaller, and skull of more slender proportions.

Color.—Practically as in *zacatecae*.

Skull.—Size and general form much as in *goldmani*, but zygomata more widely spreading posteriorly; audital bullae more inflated, bulging farther below level of basioccipital; incisors broader. Similar in general to that of *zacatecae*, but much smaller, more smoothly rounded and comparatively delicate in structure.

Measurements.—Type: Total length, 185 mm.; tail vertebrae, 55; hind foot, 26. An adult male topotype: 190; 65; 26. Average of three adult female topotypes: 176 (165–185); 56 (50–60); 25 (24–25). *Skull:* see table, p. 107.

Remarks.—This subspecies is nearly related to its geographic neighbor, *goldmani*, which occurs at lower elevations in the basin-like depression embracing eastern Durango. It is readily distinguished externally by the darker general coloration, and especially the buffy instead of entirely white forearms.

Specimens examined.—Six, all from the type locality.

Thomomys umbrinus goldmani Merriam

Thomomys goldmani Merriam, Proc. Biol. Soc. Washington, vol. 14, p. 108, July 19, 1901. Type from Mapimi, Durango, Mexico (altitude 3,800 feet).

Distribution.—Arid interior basin, or sink, in northeastern Durango known as the Bolson de Mapimi, probably ranging into adjoining parts of southwestern Coahuila.

Thomomys umbrinus perditus Merriam

Thomomys perditus Merriam, Proc. Biol. Soc. Washington, vol. 14, p. 108, July 19, 1901. Type from Lampazos, Nuevo Leon, Mexico.

Distribution.—Arid plains and high mountains in eastern Coahuila, northern Nuevo Leon, and north to western Texas.

Thomomys umbrinus evexus, subsp. nov.

Type.—From Mount San Gabriel, northwestern Durango, Mexico (between 7,000 and 9,000 feet altitude). No 21208, ♀ adult, skin and skull, American Museum of Natural History, collected by J. H. Batty, January 28, 1903. Original number 188.

Distribution.—Known only from the type locality.

General characters.—A small subspecies closely allied to *T. u. durangae* but color darker, and cranial characters distinctive. Somewhat similar to *T. u. goldmani* but color much darker, the general tone of upper parts extending down over flanks, forearms and under parts (flanks, forearms and under parts white in *goldmani*); skull differing in detail.

Color.—Type: Upper parts near russet, slightly darkened by black-tipped hairs, becoming lighter, more cinnamon along flanks, forearms, and on under parts; cheek pouches lined with white; chin white; feet grayish; tail brownish above and below, becoming white all around near tip.

Skull.—Closely resembling that of *goldmani*, but braincase broader and flatter; nasals narrower; bullae small and slightly inflated as in *goldmani*. Very similar to that of *durangae*, but braincase broader and flatter; bullae less fully inflated.

Measurements.—Type (dry skin): Total length, 206 mm.; tail vertebrae, 65; hind foot, 25. *Skull:* see table, p. 107.

Remarks.—T. u. evexus is based on a single specimen from an outlying mountain along the eastern side of the Sierra Madre. It is more closely allied to the small subspecies inhabiting the plains region to the east than to the larger forms that range along the continental backbone.

Thomomys umbrinus madrensis, subsp. nov.

Type.—From Pilares Canyon, 10 miles northeast of Colonia Garcia, and about 25 miles southwest of Casas Grandes, Chihuahua, Mexico (altitude 6,400 feet). No. 98203, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, June 23, 1899. Original number 13810.

Distribution.—Known only from the vicinity of the type locality in the Sierra Madre, northwestern Chihuahua.

General characters.—A large, rather dark form, closely allied to *sheldoni*, but paler and duller, the lighter element nearer cinnamon or mikado brown instead of tawny; skull distinctive; pectoral mammae one pair as in *sheldoni*. Very similar in color to *intermedius* and *burti*, but lacking the distinct black median dorsal line characterizing the latter, and cranial details different.

Color.—Type (acquiring fresh pelage): Upper parts between cinnamon and mikado brown, purest along sides, thinly mixed with black on head and over back; outer sides of

forearms and thighs like sides; under parts overlaid with cinnamon; feet whitish; tail brownish above, grayish below.

Skull.—Large and angular, with upper incisors distinctly recurved; maxillary arms of zygomata broad and heavy, evenly convex along line of contact with premaxillae and frontals. Size and general form much as in *sheldoni*, but rostrum broader; zygomata less widely spreading posteriorly; bullae more inflated, bulging farther below level of basioccipital; upper incisors more strongly recurved, less projecting forward. Similar to skulls of *intermedius* and *burti*, but larger, more angular, the temporal ridges and lambdoid crest more prominent.

Measurements.—Type: Total length, 208 mm.; tail vertebrae, 59; hind foot, 27.5. An adult male topotype: 195; 65; 28. An adult female topotype: 201; 59; 29. *Skull:* see table, p. 107.

Remarks.—T. u. madrensis is one of the connecting links in the chain of forms extending along the continental backbone from the southern end of the plateau region of Mexico to southeastern Arizona and southwestern New Mexico.

Specimens examined.—Nineteen, all from Chihuahua, as follows: Pacheco, 11 (Mus. Comp. Zool.); Pilares Canyon, 10 miles northeast of Colonia Garcia (type locality), 8.

Thomomys umbrinus caliginosus, subsp. nov.

Type.—From eight miles west of Altamirano, Sierra Madre, northwestern Chihuahua, Mexico (altitude 8,000 feet), near Sonora boundary west of Casas Grandes. No. 250887, ♂ adult, U. S. National Museum (Biological Survey collection), collected by Vernon Bailey and Frederic Winthrop, November 3, 1932. Original number 11071.

Distribution.—Known only from along the crest of the Sierra Madre, northwestern Chihuahua.

General characters.—Closely allied to *T. u madrensis*, but smaller; color still darker; skull smaller and of slenderer proportions. Similar in size to *T. u. intermedius* and *T. u. burti*, but color darker, the back more broadly and uniformly overlaid with black, and cranial details distinctive.

Color.—Type: Upper parts in general russet, mixed with black, becoming mikado brown along sides and on forearms; under parts overlaid with mikado brown, the dark plumbeous under color showing through; cheek pouches lined with white; lips whitish; feet whitish, but dusky of ankles extending a short distance over metatarsus; tail irregularly mottled white and black, becoming white all around near tip.

Skull.—Similar to that of *madrensis*, but distinctly smaller and lighter in structure, nasals more projecting over incisors anteriorly. Compared with *intermedius* and *burti* the skull is more slender; rostrum narrower; nasals more projecting over incisors anteriorly, less wedge-shaped posteriorly; zygomata weaker; pterygoids narrower, more knife-like (broader with distinct lateral wings in *intermedius* and *burti*); upper incisors narrower, strongly recurved as in *intermedius* and *burti*.

Measurements.—Type: Total length, 200; tail vertebrae, 59; hind foot, 25. Two adult female topotypes: 197, 192; 56, 52; 26, 25. *Skull:* see table, p. 107.

Remarks.—T. u. caliginosus is a high mountain form distinguished from *madrensis*, which occurs at lower elevations in the same general region, mainly by still darker coloration and smaller size.

Specimens examined.—Nine, all from Chihuahua, as follows: Altamirano (8 miles west), 5 (3 in Mus. Comp. Zool.); Colonia Garcia, 4 (Amer. Mus. Nat. Hist.).

Thomomys umbrinus emotus Goldman

Thomomys fulvus emotus Goldman, Proc. Biol. Soc. Washington, vol. 46, p. 76, Apr. 27, 1933. Type from Animas Peak, Animas Mountains, New Mexico (altitude 8,000 feet).

Distribution.—Known only from the upper slopes of the Animas Mountains, southwestern New Mexico.

Thomomys umbrinus chiricahuae, subsp. nov.

Type.—From Pinery Canyon, west slope of Chiricahua Mountains, Arizona (altitude 7,500 feet). No. 247828, ♂ adult, U. S. National Museum (Biological Survey collection), collected by George G. Cantwell, April 28, 1927. Original number 2918.

Distribution.—Known only from the Chiricahua Mountains.

General characters.—Closely allied to *T. u. intermedius*; size about same; upper parts near cinnamon instead of cinnamon brown, the back more uniform and usually lacking the distinct black median dorsal area extending from top of head to rump in *intermedius*; pectoral mammae one pair; cranial details different. Similar to *T. u. madrensis* but upper parts lighter, more cinnamon, and skull characters distinctive. Similar in color to *T. u. emotus*, but skull more elongated, and differing in detail.

Color.—Type: Upper parts near cinnamon, lightest along sides, the top of head and back nearly uniformly mixed with black; outer sides of forearms and thighs pinkish buff; under parts overlaid with pale pinkish buff or buffy grayish; feet whitish; tail brownish above, whitish below.

Skull.—Very similar to those of *intermedius* and *burti*, but nasals less wedge-shaped, broader and usually less uniformly emarginate posteriorly; pterygoids narrower, with less developed lateral wings as viewed from below; audital bullae more inflated, bulging farther below level of basioccipital. Compared with that of *madrensis* the skull is narrower, with less widely spreading zygomata; rostrum and premaxillae more slender; nasals usually projecting farther over upper incisors which are rather strongly recurved; audital bullae more rounded and inflated anteriorly. More elongated than that of *emotus*, with nasals longer but less wedge-shaped and broader posteriorly; audital bullae larger, more inflated.

Measurements.—Type: Total length, 210 mm.; tail vertebrae, 74; hind foot, 27. An adult male topotype: 190; 60; 26. Average of three adult female topotypes: 198 (190–205); 69 (62–74); 27 (27–27). *Skull:* see table, p. 107.

Remarks.—T. u. chiricahuae occurs at a rather high altitude (7,500 feet) in the same range of mountains as the animal described as *Thomomys fulvus collinus* from near the summit. Specimens of *chiricahuae* were erroneously referred to *collinus* by the junior author in 1931 (Journ. Washington Acad. Sci., vol. 21, no. 17, p. 422, Oct. 19, 1931). These two gophers, now regarded as specifically distinct, are found in close proximity but probably not sharing the same local terrain. The new form is very similar to *collinus*, but is darker with a single pair (instead of two pairs) of pectoral mammae, a more smoothly rounded skull, and smaller bullae.

Specimens examined.—Six, all from the type locality.

Thomomys umbrinus intermedius Mearns

Thomomys fulvus intermedius Mearns, Proc. U. S. Nat. Mus., vol. 19, p. 719, July 30, 1897. Type from summit of Huachuca Mountains, Arizona (altitude 9,000 feet).

Distribution.—Upper slopes of Huachuca Mountains, Arizona.

Thomomys umbrinus burti Huey

Thomomys burti Huey, Trans. San Diego Soc. Nat. Hist., vol. 7, no. 15, p. 158, July 28, 1932. Type from Madera Canyon, Santa Rita Mountains, Arizona (altitude 6,000 feet).

Distribution.—Known only from the upper slopes of the Santa Rita Mountains, Arizona.

Thomomys umbrinus sonoriensis, subsp. nov.

Type.—From 10 miles east of Chinapa, Sonora River Valley, northern Sonora, Mexico (altitude 3,000 feet). No. 250893, ♂ old adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Vernon Bailey and Frederic Winthrop, November 21, 1932. Original number 11135.

Distribution.—Irregularly broken or mountainous region west of the Sierra Madre in northeastern Sonora.

General characters.—Closely allied to *T. u. burti* and *T. u. intermedius*; pectoral mammae, one pair; color about the same; black median dorsal area from top of head to rump broad and distinct as in *burti* and *intermedius*; skull heavier and differing in detail. Similar to *T. u. caliginosus*, but color lighter and skull more massive.

Color.—Type (fresh winter pelage): Upper parts near wood brown, purest on cheeks, shoulders and upper part of sides, interrupted along median line from top of head to rump by a broad blackish area; under parts in general thinly overlaid with paler wood brown, the dark plumbeous under color showing through; cheek pouches lined with white; outer sides of forearms and thighs like under parts; ears encircled by black; feet whitish, except proximal half of upper surface of metatarsus which is dusky; tail dusky above, slightly paler below to near tip which is white all around. A topotype is more cinnamon brown in general tone.

Skull.—Very similar to those of *burti* and *intermedius* but broader, more massive; rostrum broader across base, narrowing anteriorly; nasals shorter, but broader posteriorly (deeply emarginate as in *burti* and *intermedius*); maxillary arm of zygoma heavier; upper incisors broader, more projecting forward. Compared with that of *caliginosus* the skull is broader, more massive, with rostrum broader; nasals and premaxillae broader; maxillary arm of zygoma heavier; pterygoids broader; upper incisors broader, more projecting forward beyond nasals.

Measurements.—Type: Total length, 220 mm.; tail vertebrae, 60; hind foot, 26. An adult female topotype: 192; 52; 27. *Skull:* see table, p. 107.

Remarks.—In the more essential features, including the black dorsal area extending from top of head to rump, this subspecies shows close relationship to the high mountain forms *burti* and *intermedius* of southern Arizona. The cranial details pointed out appear to be quite distinctive.

Specimens examined.—Four, all from Sonora, as follows: Chinapa (10 miles east), 2 (1 in Mus. Comp. Zool.); Huasabas, 2 (Amer. Mus. Nat. Hist.).

Thomomys umbrinus eximius, subsp. nov.

Type.—From Sierra de Choix, about 20 miles northeast of Choix, Sinaloa, Mexico (altitude 5,000 feet). No. 96458, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by E. A. Goldman, October 19, 1898. Original number 13137.

Distribution.—Upper slopes of Sierra de Choix, a western spur of the Sierra Madre, northern Sinaloa.

General characters.—A small, dark-colored subspecies, closely resembling *T. u. sheldoni*, but decidedly smaller; cranial characters distinctive. Somewhat similar to *T. u. chihuahuae*, but much smaller and color darker.

Color.—Type: Upper parts near mikado brown, heavily mixed with black, becoming paler and near cinnamon along sides; outer surface of forearms and thighs like sides of body; under parts overlaid with cinnamon buff; muzzle blackish; feet grayish; tail light brownish above and grayish below, becoming grayish all around near tip.

Skull.—Similar in general to that of *sheldoni*, but much smaller and of slenderer pro-

portions; nasals relatively narrower, truncate instead of emarginate posteriorly; upper incisors more strongly recurved. Differing from *chihuahuae* mainly in much smaller size.

Measurements.—Type: Total length, 194 mm.; tail vertebrae, 64; hind foot, 27.5. An adult female topotype: 187; 60; 27. *Skull:* see table, p. 107.

Remarks.—T. u. eximius appears to be a well-marked subspecies with a range at the middle elevation along the western slope of the Sierra Madre.

Specimens examined.—Four, all from the type locality.

Thomomys umbrinus atrovarius Allen

Thomomys atrovarius Allen, Bull. Amer. Mus. Nat. Hist., vol. 10, p. 148, Apr. 12, 1898. Type from Tatemales (near Rosario), Sinaloa, Mexico.

Distribution.—Coastal plain from southern Sinaloa south to central Nayarit.

Thomomys umbrinus musculus, subsp. nov.

Type.—From Pedro Pablo (about 22 miles east of Acaponeta), Sierra de Teponahuaxtla, Nayarit, Mexico (altitude 3,500 feet). No. 90818, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, August 3, 1897. Original number 11440.

Distribution.—Tropical western slopes of Sierra Madre in southern Sinaloa and northern Nayarit.

General characters.—A dark, nearly unicolored subspecies, closely allied to *T. u. atrovarius*, but smaller; color mouse brown or hair brown instead of blackish; skull differing in detail. Cranial characters indicating near relationship to *T. u. sheldoni*. Contrasting with *sheldoni* in nearly uniform dark coloration, and coarse, sparse pelage.

Color.—Type: Upper and under parts in general near hair brown, somewhat darker above than below; feet and tail whitish.

Skull.—Similar to that of *T. u. atrovarius*, but smaller; nasals relatively narrower; audital bullae relatively smaller, less inflated below level of basioccipital. Compared with that of *sheldoni* the skull is smaller, with relatively narrower nasals and interorbital region.

Measurements.—Type: Total length, 202; tail vertebrae, 64; hind foot, 28. An adult male and female, respectively, from Plomosas, Sinaloa: 200, 186; 63, 64; 27, 27. *Skull:* see table, p. 107.

Remarks.—T. u. musculus is a mountain form, similar in color and evidently closely allied to *atrovarius* of the coastal plains region. It differs strongly from *sheldoni* in external appearance, but the slight divergence in important cranial details seems to warrant subspecific treatment.

Specimens examined.—Three, from localities as follows:

SINALOA: Plomosas, 2.

NAYARIT: Pedro Pablo (type locality), 1.

Thomomys umbrinus extimus, subsp. nov.

Type.—From Colomo, southern Nayarit, Mexico (altitude 600 feet). No. 88131, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, April 5, 1898. Original number 10878.

Distribution.—Arid tropical coastal plains in extreme southern Nayarit; probably intergrading to the northward with *T. u. atrovarius*.

General characters.—A dark subspecies, closely allied to *T. u. atrovarius*, but more brownish, less blackish than usual in that form; size much larger; cranial details, especially the widely spreading zygomata, distinctive; pelage sparse and coarse as in *atro-*

varius. Differing from *T. u. musculus* in wood brown instead of hair brown color, and decidedly larger size.

Color.—Type: Upper parts near wood brown, heavily mixed with black, the black predominating on top of head and median dorsal area, and plumbeous basal color showing through everywhere; sides distinctly lighter than back; under parts light drab, thinly haired, the skin visible beneath; anterior half of forearms, fore and hind feet grayish; tail very thinly clothed, the hairs light brownish above, grayish below.

Skull.—Similar to that of *atrovarius*, but decidedly larger and heavier; zygomata more widely and squarely spreading anteriorly; bullae relatively smaller; dentition heavy, the upper incisors projecting forward as in *atrovarius*. Closely resembling that of *musculus*, but much larger; zygomata squarely spreading anteriorly as in *musculus*.

Measurements.—Type: Total length, 235; tail vertebrae, 75; hind foot, 31.5. *Skull:* see table, p. 107.

Remarks.—T. u. extimus, from the arid tropical coastal plains of extreme southern Nayarit, is based upon a single specimen presenting differential characters that seem worthy of subspecific recognition. It requires close comparison only with *atrovarius*.

Thomomys simulus, sp. nov.

[Descriptions under subspecies]

Distribution.—Subtropical, lower slopes of Sierra Madre in central western Durango and probably adjoining parts of Sinaloa, and north to Alamos River Valley, southern Sonora.

Thomomys simulus simulus, subsp. nov.

Type.—From Alamos, southern Sonora, Mexico (altitude 1,200 feet). No. 96463 ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by E. A. Goldman, December 29, 1898. Original number 13339.

Distribution.—Alamos River Valley in the vicinity of the type locality, southern Sonora, probably ranging northward along the western basal slopes of the Sierra Madre.

General characters.—A rather small, cinnamon buff subspecies with a narrow, smoothly rounded skull. Somewhat similar to *Thomomys umbrinus atrovarius* but cinnamon buff instead of brownish black in color and cranial characters suggesting specific distinction. Somewhat similar to *T. u. sonoriensis*, *T. u. intermedius* and *T. u. burti*, but color paler, lacking the black median dorsal line so characteristic of these, and skull differing in detail. Paler than *T. u. madrensis* and skull combining differential features.

Color.—Type (acquiring winter pelage): Upper parts near cinnamon, purest on sides, forearms, and thighs, thinly mixed with black on head and over back; under parts overlaid with light cinnamon buff, the basal color rather light plumbeous; feet whitish; tail nearly unicolor, thinly clothed with whitish hairs.

Skull.—Similar in general to that of *atrovarius*, but zygomata less widely spreading; rostrum usually deeper, the nasals less depressed anteriorly; basioccipital narrower, less wedge-shaped, the sides more nearly parallel; audital bullae more fully inflated; incisors more recurved, less projecting anteriorly. Similar in general to those of *sonoriensis*, *intermedius* and *burti*, but nasals broader, less deeply emarginate posteriorly; pterygoids usually narrower, more knife-like, with a less developed lateral wing as viewed from below; basioccipital narrower; bullae more inflated, bulging farther below level of basioccipital. Not very unlike that of *madrensis*, but braincase more smoothly rounded, the lambdoid crest less prominent; basioccipital narrower; bullae more inflated, bulging farther below level of basioccipital.

Measurements.—Type: Total length, 197 mm.; tail vertebrae, 59; hind foot, 26.5. An adult male topotype: 197; 65; 30. Average of three adult female topotypes: 197 (193–204); 63 (59–70); 28 (27–30). *Skull:* see table, p. 107.

Remarks.—In combination of cranial characters *Thomomys simulus simulus* stands somewhat apart from the *umbrinus* series of closely allied forms. It is readily distinguished from *atrovarius*, which inhabits the tropical lowlands to the southward, by the contrasting color and cranial characters pointed out. In one of the females two pectoral mammae have been functional on one side and one on the other, a deviation from the single pair normally present in the *umbrinus* group.

Specimens examined.—Five, from the type locality

Thomomys simulus parviceps, subsp. nov.

Type.—From Chacala, western Durango, Mexico (altitude 3,000 feet). No. 96743, ♀ young adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by E. A. Goldman, March 6, 1899.

Distribution.—Subtropical western slope of Sierra Madre in western Durango and probably adjoining parts of Sinaloa.

General characters.—Allied to *T. s. simulus*, but smaller, very much darker and skull narrower; pectoral mammae, one pair. Similar in color to *T. umbrinus atrovarius*, but less blackish; size smaller; the narrow skull, with recurved upper incisors is quite distinctive.

Color.—*Type:* Upper and under parts plumbeous black, finely and nearly uniformly, but inconspicuously overlaid with wood brown, this color somewhat more in evidence on cheeks and outer sides of forearms; feet light brownish, tinged with grayish; tail brownish above, somewhat lighter below, becoming grayish all around near tip.

Skull.—Small and narrow, with narrow basioccipital, prominent bullae and recurved upper incisors. Similar to that of *simulus*, but much smaller, with relatively narrower braincase; basioccipital with sides nearly parallel between well-rounded bullae, and upper incisors recurved as in *simulus*. Compared with that of *T. umbrinus atrovarius* the skull is smaller and relatively as well as actually narrower; nasals relatively broader posteriorly, emarginate instead of truncate between ends; bullae more inflated, bulging farther below basioccipital; basioccipital narrower, less wedge-shaped, the sides more nearly parallel between bullae; upper incisors more strongly recurved.

Measurements.—*Type:* Total length, 177 mm.; tail vertebrae, 62; hind foot, 26.5. *Skull:* see table, p. 107.

Remarks.—*T. s. parviceps* is based on a single individual from the subtropical belt along the western side of the Sierra Madre. It presents characters that seem to warrant subspecific recognition. In color it approaches *T. u. atrovarius*, but the cranial characters indicate closer relationship to *T. s. simulus*.

Thomomys bottae Group

Thomomys bottae (Eydoux and Gervais)

Oryctomys (*Saccophorus*) *bottae* Eydoux and Gervais, Mag. de Zool., vol. 6, p. 23, pl. 21, fig. 4, 1836. Type from "coast of California," probably vicinity of Monterey.

Thomomys bottae Baird, Proc. Acad. Nat. Sci. Philadelphia, vol. 7, p. 335, 1855.

Distribution.—Widely dispersed in the southwestern United States and Lower California, ranging south on the Mexican mainland to northern Durango, and central Sinaloa.

Thomomys bottae toltecus Allen

Thomomys toltecus Allen, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 52, Apr. 28, 1893. Type from Colonia Juarez, Chihuahua, Mexico.

Thomomys fulvus toltecus Bailey, North Amer. Fauna, No. 39, p. 86, Nov. 15, 1915.

Distribution.—Plains and valleys of northwestern Chihuahua, southwestern New Mexico and southeastern Arizona.

Thomomys bottae modicus Goldman

Thomomys fulvus modicus Goldman, Journ. Washington Acad. Sci., vol. 21, no. 17, p. 418, Oct. 19, 1931. Type from La Osa, southern end of Altar Valley, Pima County, Arizona.

Distribution.—Desert plains and valleys of central southern Arizona, and adjoining parts of Sonora (Santa Cruz River; 23 kilometers south of Nogales).

Thomomys bottae phasma Goldman

Thomomys fulvus phasma Goldman, Proc. Biol. Soc. Washington, vol. 46, p. 72, Apr. 27, 1933. Type from Tule Tank, Tule Desert, near Mexican Boundary, Yuma County, Arizona.

Distribution.—Lower part of Gila River Valley and desert region of southwestern Arizona, from Colorado River east at least to Quitobaquito, ranging south into northwestern Sonora.

Thomomys bottae winthropi, subsp. nov.

Type.—From Hermosillo, Sonora, Mexico. No. 251028, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Frederic Winthrop and Bernard Bailey, December 21, 1932.

Distribution.—River valleys and plains region of central Sonora, from Magdalena south at least to Ortiz.

General characters.—Similar to *Thomomys bottae sinaloae* but larger; general color near wood brown instead of cinnamon in fresh winter pelage; pectoral mammae, 2 pairs. Very similar in color to *Thomomys bottae modicus*, but larger, with skull decidedly broader, more massive.

Color.—*Type* (fresh winter pelage): Upper parts near wood brown with a buffy suffusion, thinly mixed with black, becoming cinnamon on flanks, forearms and thighs; under parts overlaid with pinkish buff; muzzle blackish, except lips which are whitish; feet white; tail light brownish above, grayish below. Specimens in summer pelage are more cinnamon buffy.

Skull.—Very similar to that of *sinaloae*, but decidedly larger. Compared with that of *modicus* the skull is much larger, more angular and massive; zygomata relatively more widely spreading; bullae less inflated, less bulging below basioccipital; incisors broader.

Measurements.—*Type:* Total length, 255 mm.; tail vertebrae, 73; hind foot, 35. An adult female topotype: 235, 76; 34. *Skull:* see table, p. 107.

Remarks.—*T. b. winthropi* is characterized mainly by its large size. The typical form may be restricted to the Sonora River Valley. Specimens from Magdalena are somewhat smaller and apparently grading toward *modicus*. A specimen from Ortiz, on the other hand, suggests gradation toward *sinaloae*.

Specimens examined.—Thirteen, all from Sonora, as follows: Hermosillo (type locality), 6; Magdalena, 6; Ortiz, 1.

Thomomys bottae divergens, subsp. nov.

Type.—From four miles west of Huachinera, Bavispe River, northeastern Sonora, Mexico (altitude about 4,000 feet). No. 250892, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Vernon Bailey and Frederic Winthrop, November 8, 1932. Original number 11098.

Distribution.—Upper part of Bavispe River Valley, Sonora and along Aros River Valley into western Chihuahua.

General characters.—A large, rather dark subspecies. Similar to *T. u. winthropi* and

T. u. modicus, but darker than either, the upper parts more cinnamon and more heavily mixed with black; skull characters distinctive. Differing from *T. u. sinaloae* in longer, denser pelage, darker upper parts, and in cranial details.

Color.—Type (winter pelage): Upper parts near cinnamon, purest on sides, forearms and thighs, mixed with black over dorsum, the black predominating along the median line from top of head to rump; under parts overlaid with cinnamon buff; fore and hind feet, including wrists and ankles all around, white; tail light brownish above, grayish below. In one specimen from Bacerac the under parts are overlaid with white, faintly tinged with buff across abdomen.

Skull.—Similar to that of *winthropi* but narrower, less angular and less massive; nasals broader posteriorly, less wedge-shaped, the sides therefore more nearly parallel; ascending branches of premaxillae narrower posteriorly; bullae smaller. Compared with that of *modicus*, larger, with more squarely spreading zygomata; rostrum less constricted in front of zygomata; nasals less wedge-shaped, broader posteriorly; lacrimals heavier; incisors broader. Skull longer, narrower, less angular than in *sinaloae*; nasals broader posteriorly, the sides more nearly parallel; premaxillae narrower; bullae smaller, less inflated.

Measurements.—Type: Total length, 255 mm.; tail vertebrae, 77; hind foot, 36. An adult female topotype: 225; 66; 32. *Skull:* see table, p. 107.

Remarks.—T. b. divergens is closely allied to neighboring forms of the *bottae* group, but the combination of color and cranial details is distinctive. It probably has an extensive range in the river valleys west of the Sierra Madre.

Specimens examined.—Six, from localities as follows:

CHIHUAHUA: Chuichupa, 1 (Mus. Comp. Zool.).

SONORA: Bacerac, 3 (1 in Mus. Comp. Zool.); Huachinera (type locality), 2 (1 in Mus. Comp. Zool.).

Thomomys bottae convergens, subsp. nov.

Type.—From Costa Rica Ranch, delta of Sonora River, southwest of Hermosillo, Sonora, Mexico. No. 250894, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Vernon Bailey and Frederic Winthrop, December 13, 1932. Original number 11280.

Distribution.—Low desert plains of central western Sonora.

General characters.—A large, rather light-colored subspecies. Similar to *T. b. winthropi* but paler, more buffy, the upper parts varying from cinnamon buff to pinkish buff and less heavily mixed with black; under parts also usually paler; skull differing in detail. Decidedly paler than *T. b. sinaloae*, and cranial features different. Relatively light color indicating close relationship to *T. b. phasma*, but less extreme pallor and combination of cranial characters quite distinctive.

Color.—Type (acquiring winter pelage): Upper parts near cinnamon buff, purest on flanks, forearms, and thighs, the top of head and back thinly mixed with black; under parts overlaid with pinkish buff; muzzle blackish, except lips which are whitish; ears encircled by deep, glossy black; feet white; tail light brownish above, whitish below, becoming white all around toward tip. A topotype is paler than the type, the general tone above pale pinkish buff mixed with black.

Skull.—Similar to those of *winthropi* and *sinaloae*, but rostrum narrower; zygomata narrowing, the sides distinctly converging anteriorly. Compared with that of *phasma* the skull is larger, with zygomata more convergent anteriorly; upper incisors less recurved, more projecting forward.

Measurements.—Type: Total length, 235; tail vertebrae, 76; hind foot, 35. *Skull:* see table, p. 107.

Remarks.—*T. u. convergens* appears to be a fairly well marked form although it closely adjoins *winthropi* in geographic range. The pale coloration suggests probable intergradation with *phasma* along the coastal plains of northwestern Sonora.

Specimens examined.—Four, from the type locality.

Thomomys bottae sinaloae Merriam

Thomomys sinaloae Merriam, Proc. Biol. Soc. Washington, vol. 14, p. 108, July 19, 1901. Type from Altata, Sinaloa, Mexico.

Distribution.—Coastal plains from southern Sonora south to central Sinaloa.

Thomomys baileyi baileyi Merriam

Thomomys baileyi Merriam, Proc. Biol. Soc. Washington, vol. 14, p. 109, July 19, 1901. Type from Sierra Blanca, Texas.

Distribution.—Western Texas.

Thomomys baileyi mearnsi Bailey

Thomomys mearnsi Bailey, Proc. Biol. Soc. Washington, vol. 27, p. 117, July 10, 1914. Type from Gray Ranch, about 20 miles north of Mexican boundary, Animas Valley, southwest corner of New Mexico (altitude, 5,000 feet).

Distribution.—Elevated plains in southwestern New Mexico and northwestern Chihuahua.

Thomomys baileyi nelsoni Merriam

Thomomys nelsoni Merriam, Proc. Biol. Soc. Washington, vol. 14, p. 109, July 19, 1901. Type from Parral, Chihuahua, Mexico.

Distribution.—Arid interior plains from northern Durango north through central Chihuahua at least to Gallego.

U. S. National Museum and U. S. Biological Survey, Washington, D. C.

THE LANGURS OF THE PRESBYTIS FEMORALIS GROUP

By Gerrit S. Miller, Jr.

The langurs of the *Presbytis femoralis* group or section form a part of the larger *aygula* group as it was defined by Pocock in 1928 (Journ. Bombay Nat. Hist. Soc., vol. 32, p. 425, pl. 1, fig. 2, January 15, 1928). Among the members of the genus *Presbytis* the monkeys of the *femoralis* group are characterized by a color pattern consisting of nearly uniform brown (ranging from drab to almost black) upperparts of body and outer side of limbs (tending to be less dark on neck, shoulders and anterior half of back), with no conspicuous pale markings on head or elsewhere, except, in a few species, a contrastedly grayish or whitish patch on the posterior surface of the thigh. The underparts are either very pale buff throughout or are variously darkened by brown suffusions, which, in the most extreme instances, cover the entire area from chin to navel or slightly beyond, leaving only the postumbilical region pale. Invariably the pale ventral area, whatever its extent, is continued

downward as a broad, sharply defined stripe on the inner surface of the thigh (whence the name *femoralis*). At knee the pale stripe usually narrows abruptly; but it may be nearly always seen to continue downward almost or quite to the heel, in some species as a sharply defined line, in others as a mere trace. Upper surfaces of hands and feet blackish. Upper surface of tail about concolor with back. The under surface of the tail in some species is essentially concolor with the upper surface; in others it is marked with a conspicuous pale ventral stripe that covers the entire under side from base to slightly beyond middle, then rapidly narrows and becomes indistinct. The lengthened, rather stiff hairs on the forehead usually radiate from one or two centers. On top of head the (usually darker) hairs at each side continue uninterruptedly backward while those in the middle come into conflict with the median forward-growing stream of elongated (usually less dark) hairs that extends over the nape and the hind part of the crown, thus producing an erect median ridge or crest. The skull is distinguishable from that of the members of related groups by a peculiar forward-bulging convexity of the nasal region immediately below the forehead. All the species are of medium size, adults usually ranging between the following limits: head and body 430–550; tail, 620–830; greatest length of skull, 86–99; weight 5–8 kg. (approximately 11–17 lbs.). There is no appreciable sexual difference in color of the hair. Males average somewhat larger than females.

The geographical range of the *femoralis* langurs, as at present known, extends from the middle of the Malay Peninsula (southern Tenasserim) south to Sumatra and east to Borneo. It does not include either Siam proper or Java; but several of the smaller islands that lie off the coasts of Borneo and Sumatra are inhabited by members of the group.

THE FEMORALIS-LANGUR OF SARAWAK

In Borneo the range of the *Presbytis femoralis* group appears to be restricted to the western and northern portions of the island. No member of it was met with by Dr. W. L. Abbott in the south or by Mr. H. C. Raven during nearly three years of collecting in the east. In Dutch West Borneo Dr. Abbott secured 9 topotypes of *Presbytis chrysomelas* near Pontianak (see Lyon, Proc. U. S. Nat. Mus., vol. 33, p. 567, December 24, 1907); and in the adjoining territory of Sarawak, which extends along the coast northeastward from this region, a langur identified as *chrysomelas*[1] or *femoralis*[2] has long been known. Comparison of the five skins from Sarawak in the U. S. National Museum with Dr. Abbott's series of *P. chrysomelas* shows, however, that each lot represents an animal that is distinct from the other and from *Presbytis femoralis* of Singapore. The Sarawak form may be known as:

[1] *Semnopithecus chrysomelas*, Thomas, Proc. Zool. Soc. London, 1889, p. 159.

[2] *Semnopithecus femoralis* Hose, A descriptive account of the mammals of Borneo, p. 13, 1893.

Presbytis arwasca sp. nov.

Type.—Young adult male (third molars in place and beginning to wear; basal suture not obliterated, first molar moderately worn), skin and skull, no. 83953 U. S. National Museum. Collected at Miri, Sarawak, Borneo, August, 1894, by E. and C. Hose.

Characters.—Like *Presbytis chrysomelas* (Müller) of Dutch West Borneo, but chest and throat sepia, conspicuously washed with a much lighter, drabby brown (not clear blackish brown with a sprinkling of whitish hairs); pale areas on inner surfaces of arms and legs much wider than in *P. chrysomelas* (on lower third of tibia occupying fully one-third of the leg's circumference).

Skull and teeth.—The skull and teeth do not differ appreciably from those of *Presbytis chrysomelas*.

Measurements.—External measurements of type (approximate, from well made skin): head and body 550 mm.; tail, 680; foot, 155. Cranial measurements of type and of a slightly older male *P. chrysomelas* (no. 142204 from the vicinity of Pontianak, Dutch West Borneo; basal suture closed, first molar just beginning to wear): greatest length, 94.0 and 95.0; condylobasal length, 67.6 and 73.6; zygomatic breadth, 69.0 and 70.2; postorbital constriction, 45.8 and 44.2; breadth of braincase above zygomata, 55.0 and 55.0; mandible, 62.2 and 66.8; maxillary toothrow (alveoli), 27.8 and 28.2; mandibular toothrow (alveoli), 32.2 and 33.0.

Specimens examined.—Five, from the following localities in Sarawak: Baram River, 1; Cape Datu, 1; Miri, 3.

Remarks.—Under the name "*Semnopithecus*" *femoralis* the Sarawak member of the *femoralis* group has appeared in the literature for forty years or more, but, apparently, no one has hitherto compared it directly with specimens from Singapore, the type locality of the form with which it has been identified, or with authentic material representing its nearest geographical ally, *Presbytis chrysomelas*. When such comparisons are made the distinctness of the Sarawak animal immediately becomes apparent.

LIST OF THE LANGURS OF THE PRESBYTIS FEMORALIS GROUP

Thirteen seemingly valid forms of *femoralis*-langurs have been described. All but one of these (*Presbytis dilecta* Elliot) are represented by the material in the U. S. National Museum, most of which was collected and presented by Dr. W. L. Abbott during the years 1899 to 1906.

Contrary to a custom that is now often followed I prefer to treat each of these forms as a species. I do this because, among the 72 specimens now in the National Museum, I have not found one that is intermediate or of doubtful status when all of its characteristics are taken into consideration. It is true that there is no evidence of the occurrence of more than one form at any one locality, and that all the forms are sufficiently like each other to be reasonably regarded as local derivatives of one parent stock. But the complete absence of intergrading specimens in such a large series indicates that the process of differentiation has now gone so far that each local form has become physically separated from its allies. Nearly related species thus definitely separated from each other have reached stages of evolution that differ essentially from those that have been reached by subspecies whose evolution has not yet gone far enough to do away with intermediate individuals or populations. To obscure this essential difference by the indiscriminate use of trinomial desig-

nations for all forms that seem likely to be rather recent derivatives from common ancestral stocks, and thus to lose sight of the distinction between *species* and *species groups*, adds an unnecessary difficulty to the comprehension of the facts.

KEY TO THE MEMBERS OF THE PRESBYTIS FEMORALIS GROUP

Underparts with clear buffy whitish area continued uninterruptedly from pubis to chin, occasionally with a faintly indicated dark median longitudinal area on chest.
Upperparts a dark drabby brown; upperarm nearly as dark as hand
Presbytis natunae (Thomas)
Upperparts a light drabby brown or clear drab; upperarm not nearly as dark as hand.
Pale area on posterior surface of thigh grayish, not conspicuously contrasted with surrounding parts.....*Presbytis catemana* (Lyon)
Pale area on posterior surfaces of thigh buffy whitish, conspicuously contrasted with surrounding parts.
Legs paler than back (no specimens seen) .....*Presbytis dilecta* (Elliot)
Legs not paler than back
Forehead dark brown, with no conspicuous grayish admixture
Presbytis rhionis (Miller)
Forehead grayish, rimmed with dark brown....*Presbytis cana* (Miller)
Underparts with clear buffy whitish area restricted to postthoracic region.
Under side of tail with conspicuous buffy whitish area on proximal half.
Pale postthoracic area tending to spread on side of body in front of hip; pale stripe on inner side of leg obsolete in region immediately above heel.
Length of tail 730 mm. or more; weight 16¼–17¾ lbs.
Presbytis sumatrana (Müller and Schlegel)
Length of tail 710 mm. or less; weight 14½–16½ lbs.
Presbytis batuana (Miller)
Pale postthoracic area strictly confined to ventral surface; pale stripe on inner side of leg well defined in region immediately above heel.
Chest and under side of neck blackish, inconspicuously sprinkled with white hairs; pale area on inner side of lower leg occupying much less than one-third of the circumference of the leg.....*Presbytis chrysomelas* (Müller)
Chest and under side of neck sepia, conspicuously washed with a much lighter brown; pale area on inner side of lower leg occupying fully one-third of the circumference of the leg.....*Presbytis arwasca* Miller
Under side of tail without conspicuous buffy whitish area on proximal half.
Condylobasal length of skull about 65 mm.; mandible about 60 mm.
Presbytis femoralis (Martin)
Condylobasal length of skull about 70 mm. or more; mandible about 68 mm.
Underparts uniform dark brown from umbilical region to chin; anterior margin of pale postumbilical area sharply defined; outer side of thigh without trace of gray.....*Presbytis keatii* (Robinson and Kloss)
Underparts not uniform dark brown from umbilical region to chin; anterior margin of pale postumbilical region not sharply defined; outer side of thigh often with some trace of gray.
Braincase broad (ratio of breadth above zygomata to length from glabella to lambda ranging from about 75 to 79); throat usually dusky, not contrasted with the under side of neck
Presbytis australis (Miller)

Braincase narrow (ratio of breadth above zygomata to length from glabella to lambda ranging from about 68 to 71); throat usually pale gray in obvious contrast with under side of neck
Presbytis percura (Lyon)

The described members of the *Presbytis femoralis* group, arranged alphabetically, are as follows:

1. **Presbytis arwasca** Miller (See page 126.)
2. **Presbytis australis** Miller

1913. *Presbytis australis* Miller, Smithsonian Misc. Coll., vol. 61, no. 21, p. 28. December 29, 1913.

Type locality.—Jambu Luang, east coast of Johor.

Range.—Southern part of Malay Peninsula (Johor and Pahang).

Specimens examined.—Three, from the following localities: Rumpin River, Pahang, 1; Jambu Laung, Johor, 1; Sembrong River, Johor, 1.

3. **Presbytis batuana** (Miller)

1903. *Presbytes batuanus* Miller, Smithsonian Misc. Coll., vol. 45, p. 65. November 6, 1903.

Type locality.—Pulo Pinie, Batu Islands, Sumatra.

Range.—Batu Islands off the southwest coast of Sumatra.

Specimens examined.—Ten (one infant), all from the Batu Islands, as follows: Pulo Pinie, 4; Tana Bala, 3; Tana Masa, 3.

4. **Presbytis cana** Miller

1906. *Presbytis cana* Miller, Proc. U. S. Nat. Mus., vol. 31, p. 275. September 11, 1906.

Type locality.—Pulo Kundar, Rhio Archipelago.

Range.—Pulo Kundur.

Specimen examined.—Six, all from Pulo Kundur.

5. **Presbytis catemana** Lyon

1902. *Semnopithecus sumatranus* Miller, Proc. Acad. Nat. Sci. Philadelphia, March, 1902, p. 159. Issued June 11, 1902. (Not of Müller and Schlegel, 1841.)

1908. *Presbytis catemana* Lyon, Proc. U. S. Nat. Mus., vol. 34, p. 672. September 14, 1908.

Type locality.—Kateman River, eastern Sumatra.

Range.—Coast region of eastern Sumatra in the vicinity of Amphitrite Bay.

Specimens examined.—Four, from the following localities in eastern Sumatra: Indragiri River, 2; Kateman River, 2.

6. **Presbytis chrysomelas** (Müller)

1838. *Semnopithecus chrysomelas* Müller, Tijds. Natuur. Geschied., vol. 5, p. 138.

1907. *Presbytis chrysomelas* Lyon, Proc. U. S. Nat. Mus., vol. 33, p. 567, December 24, 1907.

Type locality.—Pontianak, Dutch West Borneo.

Range.—The extreme western portion of Borneo.

Specimens examined.—Nine, from the following localities in Dutch West Borneo: Kapuas River, below Pulo Limbang, 1, below Tyan, 1, no exact locality, 1; Landak

River, at Batu Ampar, 1, no exact locality, 1; Pontianak (near), 3. Sarawak, "Poch Mountain," 1.[3]

7. Presbytis dilecta Elliot

1909. *Presbytis dilecta* Elliot, Ann. and Mag. Nat. Hist., ser. 8, vol. 4, p. 270. September, 1909.

Type locality.—Selangor, Federated Malay States.

Range.—Selangor.

Specimens examined.—No specimens seen.

Remarks.—While this paper was going through press I received from Mr. R. I. Pocock, with permission to publish them, the following notes on the type and topotype of *Presbytis dilecta* in the British Museum.

"Type of *dilecta*, ♀, undated and without exact locality other than Selangor (collected by F. H. Bellamy). Coat in poor condition owing apparently to imminence of molt which has set in on forehead leaving gray bases of hairs exposed. No median crest on forehead; occipital crest short. Hairs of arm below elbow grayish brown (faded?) paler than back. Upper parts washed out sepia brown, grayish laterally; lower side of body and inner side of limbs white; tail unicolor, like back basally, turning gradually black distally; outside and back of thighs grayish white; front of thigh with gray stripe, faint toward hip, but dusky brown over knee; outside of leg below knee gray above (blending with thigh) but darkening to gray-brown at ankle where it is sharply differentiated from black of foot. Topotype, ♀, same history. Very like type but no gray on forehead. Lower arm brown like upper arm; back and buttocks more creamy.

At the same time Mr. Pocock wrote me that the types of *Presbytis cinerea* Gray (Catal. Mamm. Brit. Mus., p. 193, 1843) and *P. nubigena* Elliot (Ann. and Mag. Nat. Hist., ser. 8, vol. 4, p. 268, September, 1909), both from Malacca, probably pertain to this species. (Gray's name, as was recognized by Sherborn, is a *nomen nudum*. See International Rules of Zoological Nomenclature, article 25 and opinion 1. Contrary to the supposition of Forbes, Trouessart and Elliot it was given no formal status by Mivart, Proc. Zool. Soc. London, 1864, p. 626.)

8. Presbytis femoralis (Martin)

1822. *Simia maura* ? Linn., Raffles, Trans. Linn. Soc. London, vol. 13, p. 247. (Singapore and Penang Island.)

1830. ? *Semn* [*opithecus*] *femoralis* Horsfield in Raffles, S., Mem. of the life and public services of Sir Thomas Stamford Raffles, p. 642 (nomen nudum).

1838. *S*[*emnopithecus*] *femoralis* Martin, Charlesworth's Mag. Nat. Hist., vol. 2, p. 436. August, 1838. (Based on the "*Simia maura* ?" of Raffles. Name restricted to the Singapore animal by Miller, 1913.)

1876. *Semnopithecus neglectus* Schlegel, Mus. d'Hist. Nat. des Pays-Bas, Rev. Méth. et Crit. des Coll., vol. VII, Simiae, p. 47. (Singapore.)

1913. *Presbytis femoralis* Miller, Smithsonian Misc. Coll., vol. 61, no. 21, p. 28, December 29, 1913.

Type locality.—Singapore. Raffles, with some hesitation, applied the name *Simia maura* "Linnaeus" (=Schreber) to the *femoralis* langurs of "Singapore and Penang." Martin corrected this mistake in nomenclature and substituted for *maura* the name

[3] This specimen (no. 83415, U. S. Nat. Mus.) obtained from a dealer in New York in 1897, has no collector's label. Its "make-up" is not unlike that of skins prepared by Hose and his agents. I have been unable to find "Poch Mountain," or a name resembling it, on any map.

femoralis (which had already been published by Horsfield as a *nomen nudum*). Although both of the localities mentioned by Raffles are essentially parts of the Malay Peninsula, Martin, for some reason not explained, gave the distribution as "Sumatra, etc." Schlegel, in 1876, went a step farther and transferred the name *femoralis* to an exclusively Sumatran animal, namely the species that he and Müller had described in 1841 as *Semnopithecus sumatranus* from Mount Ophir. At the same time he proposed the new name *Semnopithecus neglectus* for the species found at Singapore.

Unfortunately I have seen no specimens from Penang, and I consequently do not know what form of *femoralis*-langur occurs there. But Martin's description, original with him and not copied from Raffles, is perfectly applicable to the species that Doctor Abbott collected at Singapore, the first locality mentioned by Raffles. I therefore have no hesitation in designating Singapore as the type locality and in making Schlegel's *neglectus* a synonym of *femoralis*.

Range.—Apparently restricted to Singapore Island.

Specimen examined.—One.

9. **Presbytis keatii** (Robinson and Kloss)

1911. *Presbytis neglecta keatii* Robinson and Kloss, Journ. Fed. Malay States Mus., vol. 4, p. 74. April, 1911.

Type locality.—Ko-Khau, Trong, Peninsular Siam.

Range.—Middle portion of Malay Peninsula (Peninsular Siam and southern Tenasserim).

Specimens examined.—Six, from the following localities: Pensinular Siam, collected by Dr. H. M. Smith, in 1930, Kao Luang, 2; Seechol, 1; Tenasserim, Red Point, 2; Telok Besar, 1.

10. **Presbytis natunae** (Thomas and Hartert)

1894. *Semnopithecus natunae* Thomas and Hartert, Novit. Zool., vol. 1, p. 652.

Type locality.—Bunguran Island, Natuna Islands.

Range.—Natuna Islands.

Specimens examined.—Eight, all from Bunguran (or Great Natuna) Island.

11. **Presbytis percura** Lyon

1908. *Presbytis percura* Lyon, Proc. U. S. Nat. Mus., vol. 34, p. 671. September 14, 1908.

Type locality.—Kompei, eastern Sumatra.

Specimens examined.—Eleven, from the following localities on or near the northeast coast of eastern Sumatra, in the vicinity of the Siak River: Kompei, 3; Little Siak River, 2; Makapan, 3; Pulo Rupat, 1; Salat Rupat, 2.

12. **Presbytis rhionis** (Miller)

1903. *Presbytes rhionis* Miller, Smithsonian Misc. Coll., vol. 45, p. 64. November 6, 1903.

1909. *Presbytis rhionis* Lyon, Proc. U. S. Nat. Mus., vol. 36, p. 491. June 1, 1909.

Type locality.—Pulo Bintang, Rhio Archipelago.

Range.—Pulo Bintang.

Specimens examined.—Seven (one skull without skin), all from the type locality.

13. **Presbytis sumatrana** (Müller and Schlegel)

1841. *Semnopithecus sumatranus* Müller and Schlegel, in Temminck, Verhand. Nat. Ges. Nederl. Overzee. Bezitt., Zool., Mamm., p. 61 and 73, pl. 10.

1876. *Semnopithecus femoralis* Schlegel, Mus. d'Hist. Nat. Pays-Bas, Rev. méth. et Crit. des Coll., vol. 7, Simiae, p. 45. (Not *S. femoralis* Martin, 1838.)

1902. *Presbytes sumatranus* Miller, Proc. U. S. Nat. Mus., vol. 26, p. 477. February 3, 1903. (Part; specimens from Tapanuli Bay.)

1907. *P[resbytis] sumatranus* Lyon, Proc. U. S. Nat. Mus., vol. 33, p. 567. December 24, 1907.

Type locality.—Mount Ophir, about 60 km. north of Padang, Sumatra.

Specimens examined.—Four, all from Tapanuli Bay, southwest coast of Sumatra.

Remarks.—It is not certain that the specimens from Tapanuli Bay, about 225 km. northwest of Mount Ophir, represent the same animal as the one described by Müller and Schlegel. The plate that accompanies the original account of *Semnopithecus sumatranus* shows a conspicuously whitish throat; and both the plate and the description (p. 74) indicate that a broad, well defined whitish stripe extends down the under side of the arm to the wrist, and that a similar though narrower stripe runs down the lower leg to the heel, both stripes terminating in sharply outlined acute points, to which Schlegel calls special attention in his second (1876) account of the animal, under the name *femoralis*. No such arm and leg markings are present in Dr. Abbott's specimens from Tapanuli Bay or in the series of the nearly related form from the Batu Islands. In both of these series (14 skins in all) the pale area on the thigh is ill defined, and that on the lower leg is not indicated by anything more than a vague trace. On the under side of the upper arm the pale stripe is rather well developed in one specimen of *P. batuana* from Pulo Pinie (no. 121811). In all the others it is obsolete or practically absent. In no. 121811 the pale area extends inconspicuously down the forearm to the wrist; in all the others it is absent or essentially so. Arm and leg markings like those described by Müller and Schlegel occur in all but one of the 11 skins of *P. percura* from the opposite side of Sumatra about 250 km. northeast of Mount Ophir. The throat of *Presbytis percura*, though less whitish than is suggested by the plate of *P. sumatrana*, is more obviously contrasted with the dark surrounding parts than it is in the Tapanuli Bay animal or in *P. batuana*. On the other hand *Presbytis sumatrana* is described and figured as having the under side of the tail white for more than two-thirds of its length, a peculiarity that separates the animal from *P. percura* and makes it resemble the one from Tapanuli Bay. Perhaps a third Sumatran dark-chested form exists; but until specimens from Mount Ophir can be examined and the status of the original *sumatrana* can thus be positively determined I prefer to leave the names as they now stand.

VARIATION TRENDS

Individual variation within each species of *femoralis*-langur as shown by the material in the U. S. National Museum is so slight as to be practically negligible. It amounts to little more than some unimportant individual differences in the depth of color of the upperparts, in the amount and depth of the dark shading on the underparts, in the amount of grayish or whitish suffusion on the posterior surface of the thigh, and in the number and exact position of the centers of hair radiation on the forehead and on the under side of the body and neck.

The variations from species to species are, on the other hand, conspicuous and interesting. Occurring as they do in animals that live in a region where conditions of altitude, temperature, humidity, food, and enemies are extremely uniform these specific differences cannot be teleologically explained. Each species appears to be in one particular phase of the racial-physiological

process of "radiation" or "pattern making" that is, perhaps, nowhere in the world more strikingly illustrated than among the mammals of the Malay islands and mainland.[4] Because of its peculiar physiography this region offers exceptionally abundant opportunities for the isolation of animal populations under conditions that are unusually alike for all. In response to these opportunities each isolated population has tended to develop physical peculiarities of its own; and these peculiarities, unlike the predominantly pallid colors of desert mammals as compared with the dark hues of their relatives that live in humid regions, bear no apparent general relationship to the physical surroundings under which the animals exist.[5] They seem to be conditioned by physiological possibilities of variation and development that are peculiar to each stock and that are probably imposed on each stock by the hereditary influence of ancestors long extinct.

These possibilities appear to have been quite different in each of the three wide ranging Malayan groups of langurs typified, respectively, by the species *Presbytis femoralis*, *P. cristata*, and *P. obscura*, so much so that when the local species of either one of these groups are compared with those of another group no exact parallelism can be found between the ways in which they have become subdivided. This lack of parallelism pertains not only to the numbers of local species that have been developed in the different groups but also to the kind of peculiarities by which these local species are characterized. In other words the members of the three groups give no evidence of having been similarly influenced by external agencies; each set of diverging forms appears to have followed inherent tendencies peculiar to itself.

In the *Presbytis femoralis* group each species seems to represent a slight deviation from a main line of color variation that extends from the palest species to the darkest.

Elliot's description appears to indicate that *Presbytis dilecta* of Selangor, a species not represented in the National Museum collection, is the palest of all. Its upperparts are light drab and its underparts are entirely whitish. The whitish area on the posterior surface of the thigh spreads so far outward that it restricts the dark marking to a narrow line extending from hip to knee; the entire leg thus gives the impression of being lighter colored than the back. At the opposite extreme the two darkest forms, *P. keatii* of the middle part of the Malay Peninsula, and *P. chrysomelas* of northwest Borneo, have no thigh patch, and the pale area on their underparts is restricted to the post-

[4] I have discussed this process in two special papers: The Mouse-deer of the Rhio-Linga Archipelago, Proc. U. S. National Museum, vol. 37, pp. 1–9, pls. 1–3, September 1, 1909; Human hair and primate patterning, Smithsonian Misc. Coll., vol. 85, no. 10, pp. 1–13, pls. 1–5, December 19, 1931.

[5] For instance, the dark *Presbytis femoralis* and the conspicuously different pale *P. rhionis* occur under similar conditions, about 1° north of the equator, on islands that are only 40 km. apart.

umbilical region.[6] The general color is darkened to a uniform dark hair brown in one (*keatii*) and to nearly black in the other (*chrysomelas*). The chest, neck, and throat are clear brown without lighter variegation in *P. keatii*; in *P. chrysomelas* they are blackish, variegated by a sprinkling of whitish hairs that faintly trace the usual pale markings.

Next to *P. dilecta* in pallor are *P. cana* of Pulo Kundur, Rhio Archipelago, and *P. rhionis* of Pulo Bintang, Rhio Archipelago. Their general color is light drab above and pale cartridge buff throughout below, the buff spreading conspicuously from the inner surface of the thigh around to the posterior surface, thus restricting the dark area to the outer surface. In *P. cana* the long hairs of the forehead are whitish at base, imparting a characteristic gray appearance to the head. Another species with whitish underparts, *P. catemana*, occurs in the region of the Kateman River, eastern Sumatra. It is not so pallid above as *cana*, *dilecta*, and *rhionis*, and the pale area on the posterior surface of the thigh, though obvious, is grayish instead of whitish. Among the species whose underparts are entirely buff *P. natunae* of Bunguran, north of Borneo, is exceptional on account of the dark brown of its upperparts and legs, the latter being so dark that the blackish feet common to all of the species are not contrastedly darker than the legs as they are in the other members of the group. This general darkness of hue throws the whitish thigh patch into exceptionally high contrast. Another peculiarity of *Presbytis natunae* is the presence, along the median line of the chest, of a sprinkling of black hairs numerous enough to indicate, in 3 of our 8 specimens, a dark longitudinal line in the area between and below the nipples that is marked by a whitish streak in the forms with dark chests.

Three dark-backed species, *P. australis* from the east coast of Johor, *P. femoralis* from Singapore Island, and *P. percura* from eastern Sumatra, occupy the position of first stage of advance toward the dark-bellied condition. In all three of them the dark and light hairs are about equally abundant over the entire underparts in front of the buffy posterior region. A clear gray effect is thus produced that is equally different from the dark and the light extremes. They also show conditions that are intermediate between the species with and without a pale thigh patch. Thus in 3 *australis*, 1 *femoralis*, 7 *percura* and 2 *sumatrana* there is a slight pale "ticking" of the area occupied by the thigh patch in the species with entirely pale underparts, while in 5 *percura* and 3 *australis* this ticking, reinforced by the presence of many all-silvery hairs among the ringed ones, is sufficiently strong to produce thigh patches almost as well marked as those of *P. catemana*, the least "patched" of those with entirely pale underparts. Such traces of the thigh patch are

[6] Pocock (Journ. Bombay Nat. Hist. Soc., vol. 32, p. 676, May 31, 1928) described *P. keatii* as "pigmented backwards to the pubic region." I have seen poorly made up skins in which the pale postumbilical area was almost entirely obscured by shrinkage. Pocock's specimens may have been similarly distorted.

either absent or very inconspicuous in 5 *P. arwasca*, 9 *P. batuana*, 9 *P. chrysomelas* and 5 *P. keatii*, 28 specimens in all.

Except in the uniformly dark *P. keatii* the light and dark hairs on the underparts are irregularly distributed so as to adumbrate a pattern consisting of a narrow, sharply defined, whitish median longitudinal stripe margined by a darker area, and a broad, diffuse, pale band extending across the chest from axilla to axilla and continuous with the pale area on the under side of the upperarm. In front of this band the throat is slightly darker, and, in one species, *P. percura*, the chin and interramial area are again lighter. Some traces of this pattern can be seen in all the forms except *P. keatii*, with its nearly uniform dark hair-brown underparts. In *P. chrysomelas* there are relatively few pale hairs, but the contrast between the areas where these pale hairs occur and the clear, nearly black, surrounding parts is so conspicuous that the pattern can still be readily traced. The median longitudinal stripe is indicated in 7 of 9 specimens. In *P. arwasca* the dark area in front of the pale transverse band is noticeably less dark than in the one behind the band.

The fur on the back is probably never without some variegation produced by narrow whitish annulations or by a sprinkling of entirely whitish hairs. These whitish hairs occur most frequently in the species whose underparts are entirely buff.

The faint ticking due to the pale annulations of the dorsal hairs is most noticeable across the shoulders, on the upper arm, and on the posterior surface of the thigh. It is least developed in *P. chrysomelas*, *P. arwasca* and *P. keatii*, most developed in *P. femoralis* and some specimens of *P. sumatrana* and *P. batuana*. The drab species show no ticking—only an admixture of whitish hairs.

The under side of the tail usually has some trace of a pale stripe extending from the base outward beyond the middle. Among the species with darkened underparts this stripe is nearly (or sometimes quite) absent in *Presbytis keatii*, *P. australis* and *P. femoralis*; it is short and poorly developed in *P. percura* (but practically absent only once among 11 specimens); well developed and conspicuous in *P. arwasca*, *P. chrysomelas*, *P. sumatrana* and *P. batuana*. Among the four species with entirely pale underparts it is absent in one (*P. natunae*), and, in the others (*P. cana*, *P. catemana* and *P. rhionis*) it is indicated, though not very conspicuously, by an area of drab that is lighter than the drab of the back and of the upper side of the tail.

The hairs on the forehead usually radiate from one or two centers, but occasionally they stand nearly upright or incline a little backward.

When there is one center the hairs spread freely in every direction except backward where they come into conflict with the forward-growing elongated hairs of the nape and crown, thus producing an erect crest in the region between the ears. The single center of radiation may be situated either on the median line or to the right or left of it.

When there are two centers the radiating hairs come in conflict with each other along the median line where they form a ridge that extends from the margin of the bare eyebrow area backward to the main crest. The ridge varies in height according to the length of the hairs and the distance apart of the radiation centers; this distance is ordinarily about 10 mm. in dried skins. The median ridge is especially well developed in *Presbytis chrysomelas*.

Among 72 specimens there are 12 that have no center of radiation, 32 that have one center, and 28 that have two centers. These are distributed among the 12 species represented in the National Museum collection as follows:

SPECIES	SPECIMENS WITH NO CENTER OF RADIATION	SPECIMENS WITH ONE CENTER OF RADIATION	SPECIMENS WITH TWO CENTERS OF RADIATION
Presbytis arwasca	1	0	4
australis	1	1	1
batuana	1	8	0
cana	0	5	1
catemana	1	1	2
chrysomelas	0	0	9
femoralis	0	0	1
keatii	1	0	5
natunae	4	2	2
percura	0	9	2
rhionis	0	5	1
sumatrana	3	1	0
Total	12	32	28
Per cent	16.7	41.7	38.9

Though the series of specimens of each species are too small to give conclusive evidence they suggest that there are racial trends in the number of radiation centers. Thus, *Presbytis natunae* and *P. sumatrana* seem to have the strongest tendency toward non-development of these centers, *P. batuana*, *P. cana*, *P. percura*, and *P. rhionis* seem to be specializing on one center, and *P. arwasca*, *P. chrysomelas*, and *P. keatii* seem to be specializing on two centers.

The direction of hair growth on the ventral surface furnishes some striking examples of variation trends each of which appears to be rather constantly present among the individuals of the species in which it occurs.

In all of the known species the hairs of the hypogastric region grow backward, thus conforming, in direction as well as in color, with those of the inner surface of the thighs.

Farther forward the direction of the hairs swings perpendicularly outward from each side of the median line. In all of our 22 specimens of the buff-chested species (*cana*, *catemana*, *natunae*, *rhionis*), and in our 6 skins of the

very dark *P. keatii*, it continues mostly in this direction all the way forward to the throat. One of the skins of *P. australis* has the hairs arranged in this way, while two others (including the type) do not. Almost invariably in these six species the hairs along the median line of the chest grow backward. The pattern formed by these backward-directed hairs may be accentuated by a sprinkling of dark hairs in the pale-chested *P. natunae*, or the hairs may be almost all white in the dark-chested *P. australis*. Occasionally (good examples in *P. keatii*, *P. natunae* and *P. cana*) there is at each side of the median line of backward-growing hairs a narrow strip on which the hairs grow inward toward it, thus further accentuating the pattern.

In the other species (*arwasca*, *batuana*, *chrysomelas*, *femoralis*, *percura*, *sumatrana*) all the hairs on the chest are directed backward. The broad backward-growing stream that they form comes into abrupt conflict with the forward-growing hairs of the belly, so as to form a well defined, forwardly curved ridge, whose exact location cannot be determined from the dried skins, though its anterior border appears to lie somewhat in front of the level of the xiphisternum. This ridge is most strongly developed in *P. arwasca*, *P. australis*, *P. chrysomelas* and *P. percura*, in all of which the hairs behind it are as coarse as those in front of it and the impact of the two streams is definitely "head-on," and between streams of equally coarse hairs. It is less strongly developed in *P. batuana* and *P. sumatrana*, in which the hairs of the belly, except some of those immediately behind the ridge, are directed outward and are softer and more woolly in texture than those of the chest.

The line of change from buff to brown on the underparts may or may not coincide with the line along which the backward-growing hairs of the chest meet the forward-growing hairs of the belly. The variation trends in this character, so far as the present material is concerned, are as follows:

SPECIES	COLOR CHANGE COINCIDING WITH CHANGE IN HAIR DIRECTION	COLOR CHANGE NOT COINCIDING WITH CHANGE IN HAIR DIRECTION
Presbytis arwasca	5	0
australis	2	1
batuana	9	0
chrysomelas	1	8
femoralis	0	1
percura	3	8
sumatrana	4	0
Total	24	18

All of the dark-chested species except *Presbytis keatii* normally have a whitish line on the middle of the chest in the region where a hairy line is often

present in man. This line varies in length from a mere trace up to about 150 mm. (usually about 100 mm.); width, 6–10 mm.; but its presence is so constant that I have found it lacking only once (in the skin of *P. chrysomelas* from "Poch Mountain") among 42 specimens representing the 7 dark-chested species in which it occurs.

Division of Mammals, U. S. National Museum.

UPPER PLIOCENE MUSTELIDS FROM THE SNAKE RIVER BASIN OF IDAHO

By C. Lewis Gazin

Among the smaller mammals recognized in the late Pliocene assemblage from near Hagerman, Idaho, are three types of mustelids. Two of these represent the otter-like *Lutravus* and the third is a true otter. These forms are represented in the collections of the U. S. National Museum by jaws, teeth and a few limb fragments found in lake deposits exposed along the west side of the Snake River in the vicinity of the *Plesippus* quarry. The material for the most part was collected by Mr. Elmer Cook of Hagerman, during the years 1929, 1930 and 1931. I am indebted to Dr. C. L. Camp and Mr. R. A. Stirton for the loan of a *Lutravus* specimen from Oregon in the University of California collections and to Dr. Walter Granger for permitting me to borrow Miocene mustelid types in the American Museum collections.

A second otter type included in the study was collected in 1930 by an expedition from the California Institute of Technology at a locality northwest of Grand View, Idaho, in deposits which may be comparable in age to those at Hagerman. The Grand View specimen and type *Lutravus* material, the latter from Nevada, were loaned through the kindness of Dr. Chester Stock and Mr. E. L. Furlong.

An early record of the occurrence of fossil mustelid remains in the Snake River basin of Idaho is that of *Lutra piscinaria* Leidy.[1] The type of the species, an isolated tibia, preserved in the National Museum, was collected by Clarence King in about the year 1869 on Sinker Creek in the southwestern part of the state. The specimen was found in association with material identified by Leidy as representing *Equus excelsus* and *Mastodon mirificus*. It is possible that the beds exposed along Sinker Creek are somewhat younger than those at Hagerman.

Lutravus (?)[2] **idahoensis,** new species

Type.—Portion of left ramus of mandible, no. 12030, U. S. Nat. Mus., with P_4, M_1 and M_2.

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[1] Joseph Leidy, Rept. U. S. Geol. Surv. Terr. vol. 1, pp. 230–231, 316, 1873.

[2] E. L. Furlong, Carnegie Inst. of Wash., Publ. No. 418, pp. 95–103, 1932.

Locality.—T. 7 S., R. 13 E., near Hagerman, Idaho.

Horizon.—Hagerman lake beds.

Specific characters.—Size large, comparable in this respect with large individuals of *Martes pennanti*. Depth of mandible below M_1 equal to length of M_1 or slightly greater. Masseteric fossa deep. Mental foramina below P_2 and below point between P_2 and P_4. P_2 two rooted and crowded obliquely between C and P_3. P_3 and P_4 relatively short anteroposteriorly. Premolars surrounded by slight cingulum. M_1 with strong metaconid. Talonid of M_1 basined, with prominent, externally placed hypoconid and strong posterointernal ridge.

Material.—This species is represented by eight mandible portions, five of which carry one or more teeth. No. 12027 and the type, no. 12030, U.S.N.M., retain the fourth premolar and both molars in the left mandibular ramus. One specimen, no. 12617, though lacking all teeth except P_3, has the greater portion of the left ramus preserved. Two others, no. 12028 and no. 12607, possess only the carnassial. No skull portions or upper teeth were included in the collection.

Description.—The specimens referred to *Lutravus* (?) *idahoensis* vary somewhat in size but correspond rather closely in length of lower carnassial and depth of mandible

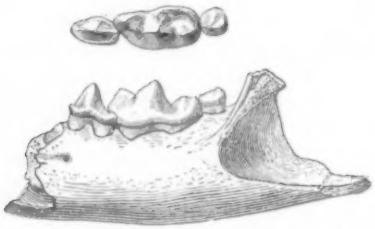

FIG. 1. *Lutravus* (?) *idahoensis*, new species. Portion of left ramus of mandible with fourth premolar and molars, type specimen, no. 12030, U.S.N.M., lateral and occlusal views. ×1. Hagerman lake beds, Upper Pliocene, Idaho. Drawing by Sydney Prentice.

below carnassial to large specimens of *Martes pennanti*.[3] The depth of mandible in the symphysial region is greater than in the fisher. The inferior margin of the mandible is convex in an anteroposterior profile but not so markedly so as in *M. pennanti*. The mental foramina in those specimens where the anterior portion of the mandible is preserved are below P_2 and below a point between P_3 and P_4. The masseteric fossa is well defined and extends forward to a point below about the middle of M_2. In specimen no. 12617 the masseteric crest or lower margin of the masseteric fossa appears to extend back towards the angle somewhat as in *Lutra lutra* or *Grison canaster* rather than rise posteriorly to the outer extremity of the condyle as in *Martes*. Also, the lower portion of the inner surface of the coronoid on this specimen does not appear to be so markedly scarred as in either *Martes* or *Lutra*, suggesting that the temporal muscle was relatively weak.

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[3] As pointed out by Pilgrim (Proc. Zool. Soc. London, 1932, pp. 860–862, 1933) *Martes* possesses a combination of primitive dental and osteological characters suggesting it to be a survival of a primitive lineage, and any differences from it may be regarded as divergence along a specialized line. Hence, comparisons made with *Martes* tend to show the direction which any specialization may have taken, and the relations to other groups.

The shortened mandible is accompanied by a reduction in the number of premolars to three. The premolars are relatively short anteroposteriorly as compared with those in the less reduced dentition of *Martes pennanti*; P_3, though two rooted, is crowded into a nearly transverse position between the canine and P_3. P_3 and P_4 are both without the accessory posterior cuspule which in *Martes* characterizes the last premolar, and is sometimes present on P_3. Moreover these teeth show a slight but distinct cingulum which is continuous around the tooth. The lower carnassial resembles M_1 in *M. pennanti*, the shearing blades being directed much as in this species and not so obliquely as in *Lutra*, but the better developed metaconid gives the fossil tooth a greater width through the protoconid-metaconid portion than in the fisher. The posterior surface of the metaconid is more nearly vertical than in *M. pennanti* and forms a more acute angle with the inner marginal ridge of the talonid. The talonid of the carnassial is well developed and somewhat wider than usual in *M. pennanti*, though not so expanded as in the otters. Furthermore, the talonid is more distinctly basined than in *M. pennanti*.[4] The inner and posterior margin of the heel exhibits a conspicuous ridge which terminates externally in the moderately prominent hypoconid. M_2 is a single rooted, nearly circular tooth which does not differ in any important respect from M_2 in the fisher. In several of the fossil specimens in which M_2 is absent the alveolar opening is nearly triangular in outline with the more constricted apex directed posteriorly.

Comparisons.—The specimens of *Lutravus* (?) *idahoensis* possess a type of dentition which is similar to that seen in the lower jaw of *Lutravus halli* Furlong[5] from the earlier Pliocene at Thousand Creek, Nevada. The lower premolars in *L. halli* are probably reduced to three as indicated in the specimen[6] from the Rattlesnake beds of Oregon. P_4 in *L. halli* is without an accessory cuspule as it is in *L.* (?) *idahoensis*. The latter, however, is clearly distinguished from *L. halli* by the relative proportions of the teeth. P_4 is distinctly smaller than in the Nevada and Oregon specimens and the premolar series is appreciably shorter than that exhibited by the Oregon specimen. The root portion of P_2 preserved in the Oregon specimen is much more robust than that in the Idaho form. M_1 in *L.* (?) *idahoensis* is less hypsodont in an unworn condition and the talonid of this tooth is more elongate. Moreover, the talonid of M_1 appears more distinctly basined and the metaconid is better developed. The characters of M_1 in *L.* (?) *idahoensis* are somewhat more otter-like than those in *L. halli*.

Grison and *Tayra* from southern Mexico and Central America are characterized by a relatively short, robust mandible carrying only three premolars. In comparison with *Lutravus* (?) *idahoensis* these forms are seen to have relatively much wider premolars, and P_2 is single rather than double rooted. The metaconid of M_1 is not so well developed and the talonid is shorter, narrower and somewhat more trenchant. The large *Tayra* is further characterized by the distinctly small size of M_1 and M_2 in contrast to the marked development of the incisors and canines.

Fossil mustelid material from the Pliocene of North America is by no means abundant. The lower teeth of *Canimartes cumminsii* Cope[7] from the Blanco formation of Texas are

[4] In the characters of the carnassial, however, it should be noted that M_1 in the small European marten, *Martes martes*, exhibits a conspicuous metaconid and a well defined talonid basin, though these two features are not so pronounced as in *Lutravus* (?) *idahoensis*. The Asiatic *Charronia flavigula* possesses a well developed metaconid on M_1 but in this form the talonid is narrow and distinctly more trenchant. A similar combination of characters for M_1 is seen in the small *Charronia flavigula saba* from the region of Borneo.

[5] E. L. Furlong, *ibid.*, plate 2, figs. 4–6, 1932.

[6] E. L. Furlong, *ibid.*, plate 2, fig. 1, 1932.

[7] E. D. Cope, Fourth Ann. Rept., Geol. Surv. Texas, 1892, pp. 51–52, plate 14, figs. 12–14, 1893.

described as being about the size of those in *Martes pennanti*. P_4 in *C. cumminsii* is described as having a small conic cusp on the middle of the short heel. The figure shows this cusp to be of conspicuous size. The metaconid of the lower sectorial, according to Cope, is large and the heel trenchant. In the figure the talonid of M_1 appears relatively short, narrow and high. Cope's species appears to have little in common other than size with *Lutravus* (?) *idahoensis*.

Pliogale furlongi (Merriam)[8] from the Thousand Creek Pliocene of northwestern Nevada is a minute mustelid apparently unrelated to *Lutravus*. From the figures given by Merriam and by Hall one receives the impression that this form, and possibly *Martinogale*,[9] may be related to the Mephitinae. *Mustela* (?) *buwaldi* Merriam[10] from the Ricardo Pliocene beds in the Mohave Desert region of California is distinctly smaller than *Lutravus* (?) *idahoensis*. The premolars in *Mustela* (?) *buwaldi* are anteroposteriorly elongate and four in number. Also, P_4 in the Ricardo form possesses a posterior accessory cuspule. The carnassial in Merriam's figure appears similar to that in *Martes*, to which genus the fossil may well belong.

Among the Miocene mustelids mention may be made of *Sthenictis bellus* Matthew[11] from the Sheep Creek beds of Nebraska. The dentition in the type mandible of *S. bellus* noticeably resembles lower teeth in large species of *Martes*, as *M. pennanti*, and as in *Charronia flavigula*. The premolars as in *M. pennanti* are more elongate and less crowded than in *C. flavigula* and the talonid of M_1 is much like that in the American form, but the depth of the ramus is relatively greater anteriorly as in *C. flavigula*, and the metaconid is somewhat better developed than in either *M. pennanti* or *C. flavigula*. *Lutravus* (?) *idahoensis* is distinguished from *S. bellus* as it is from *Martes* by having only three relatively short premolars and a more distinctly basined talonid on M_1. The metaconid of M_1 is equally prominent in the two fossil types but the posterior slope of this cusp is more gradual in *Sthenictis bellus* as it is in *M. pennanti*. An even more gradual slope to the posterior surface of the metaconid of M_1 is seen in the species of *Mionictis*[12] from the lower Snake Creek beds of Nebraska. In *Mionictis*, particularly *M. elegans*, a downward sweeping ridge extends backward from the summit of the metaconid and continues uninterrupted around the inner margin of the heel.

Smaller Miocene mustelids grouped under the genus *Plionictis*,[13] though exhibiting a metaconid on M_1, show a trenchant talonid and are presumably more nearly related to *Mustela* than to *Martes*. *Martes kinseyi* Gidley[14] from the Miocene of Montana resembles *Martes americana* but perhaps should be included in the genus *Plionictis*.

Among the fossil mustelids of Europe, *Pannonictis pliocaenica* Kormos[15] from a late Pliocene fissure breccia in Hungary corresponds most closely in the lower dentition to *Lutravus* (?) *idahoensis*. *P. pliocaenica*, as *L* (?) *idahoensis*, is characterized by three single-cusped lower premolars and a lower carnassial with a well developed metaconid and a basined heel. However, certain differences are apparent. *P. pliocaenica* is a somewhat larger form and the anterior or premolar portion of the mandible is relatively longer.

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[8] J. C. Merriam, Univ. Calif. Publ., Bull. Dept. Geol., vol. 6, pp. 249–250, fig. 22, 1911. See also E. Raymond Hall, Journ. Mammalogy, vol. 11, No. 2, pp. 146–154, 1930.

[9] E. R. Hall, *ibid.*, 1930.

[10] J. C. Merriam, *ibid.*, vol. 11, p. 542, fig. 154, 1919.

[11] W. D. Matthew, Amer. Mus. Novitates, No. 540, pp. 1–2, fig. 1, 1932.

[12] W. D. Matthew, Bull. Amer. Mus. Nat. Hist., vol. 50, pp. 136–137, fig. 36, 1924.

[13] W. D. Matthew, *ibid.*, p. 135, 1924.

[14] J. W. Gidley, Journ. Mammalogy, vol. 8, No. 3, pp. 239–242, 1927.

[15] Th. Kormos, Ann. Inst. Regii Hung. Geol., vol. 29, pp. 167–177, plate 3, figs. 1–3, 1931.

P_2 is small but not crowded as in the Idaho form. Zdansky's[16] unnamed mustelid from the Tertiary of China, which Kormos believed to represent *Pannonictis*, also exhibits a slightly more elongate premolar region with less crowded teeth than in *Lutravus* (?) *idahoensis*. The mandible in the Hungarian form deepens anteriorly and the symphysial portion is described by Kormos as being bulky. In specimen no. 12617, U.S.N.M., from Idaho in which the greater part of the ramus is preserved, the anterior or symphysial portion appears shallower than in *Pannonictis*, though deeper and more abrupt than in *Martes pennanti*. M_1 in the specimens figured by Kormos resembles in lateral view this tooth in *L.* (?) *idahoensis* but appears somewhat lower crowned, particularly the paraconid portion. A remarkably large M_1 of *Pannonictis pliocaenica* is figured by Pilgrim[17] in occlusal and lingual views. In the side view of this tooth the posterior slope of both the protoconid and metaconid appears more gradual than in *L.* (?) *idahoensis*. In occlusal view the talonid is directed more lingually than in the Idaho form giving the tooth a distinctly more arcuate appearance. This latter character is even more pronounced in the apparently more slender lower carnassial of *Enhydrictis galictoides* Major[18] from the late Pliocene of Sardinia.

The skull of *Lutravus* (?) *idahoensis* is not known but the skull portion of *Lutravus halli* described by Furlong may be further compared with the European *Pannonicitis* and the living *Grison* of southern Mexico. The rostrum of *L. halli* is broad across the palate, and the preserved portions indicate that the muzzle may have been relatively deep as in *Grison* and as apparently is true in *Pannonictis*. However, according to Kormos the infraorbital foramen in *Pannonictis* is smaller than in a badger. In *Lutravus* it is distinctly larger than in a badger, larger than in *Grison*, and nearly as large as in *Lutra*. The upper canine in *Lutravus* is much more slender than in *Pannonictis*. P^1 is moderately small and single rooted in *Lutravus*, absent or vestigial in *Pannonictis*, and absent in *Grison*. The carnassial does not show the distinctly bicuspid talon seen in the P_4 of *Pannonictis* figured by Pilgrim, or as seen in *Grison*, and in these forms the talon is situated farther forward than in *Lutravus*. The configuration of M^1 also appears distinctive. The posterior margin of this tooth is concave with the greatest anteroposterior diameter across a distinctly lingual portion of the tooth, whereas in the illustrations of *Pannonictis* the posterior margin of M^1 is nearly straight or slightly convex with the greatest anteroposterior diameter across a more medial portion of the tooth. In *Grison* this tooth is distinctly shortened anteroposteriorly. Furthermore, the protocone of M^1 in *Lutravus* is more removed from the inner margin of the tooth than appears to be the case in *Pannonictis*, and the very conspicuous protoconule on M^1 of *Grison* and as appears in the illustrations of *Pannonictis* is lacking in *Lutravus*. Several of the characters distinguishing the upper dentition of *Lutravus* from those of *Pannonictis* and *Grison* point to a relationship between *Pannonictis* and the American *Grison*. This relationship has been discussed by Kormos and by Pilgrim.

The illustrations given by Zdansky[19] for the Chinese specimen which Kormos considered as belonging to *Pannonictis* show the Chinese form to be markedly similar in the skull portion to *Lutravus*. This is noticeable in the proportions of the palate, size of the canine, development of P^1 and in the shape of M^1. However, one cannot determine from the figures given whether P_4 exhibits a tetartocone and M^1 a protoconule as seems evident in the *Grison*-like *Pannonictis*. I find no mention of these characters in Zdansky's text.

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[16] Otto Zdansky, Palaeontologia Sinica, ser. C, vol. 4, fasc. 4, pp. 17–18, plate 1, fig. 26, plate 2, figs. 1–3, 1927.

[17] G. E. Pilgrim, Proc. Zool. Soc. London, 1932, pp. 845–867, plate 1, fig. 4, 1933.

[18] see G. E. Pilgrim, *ibid.*, plate 2, fig. 2, 1933.

[19] Otto Zdansky, *ibid.*, plate 1, fig. 26, plate 2, figs. 1–3, 1927.

The Chinese specimen is apparently from a distinctly earlier horizon than *Pannonictis pliocaenica*, possibly contemporaneous with *Lutravus halli* but presumably earlier.

Remarks.—The characters of *Lutravus* as exhibited by the skull portion of *L. halli* suggest, as observed by Furlong, a relationship with the Lutrinae. A similarity is also seen between this skull portion and specimens representing the grisonine group. The lutrine affinities seem less marked in the lower dentition of *L. halli* and the differences separating this form from the Grisoninae are less obvious. The lower dentition of *L.* (?) *idahoensis* from the later Pliocene horizon at Hagerman, though clearly not belonging to a true otter, is more otter-like than that of *L. halli*. *L.*(?) *idahoensis* may well have originated in *L. halli* which in turn presumably descended from a marten-like form such as *Sthenictis*. However, this stem apparently did not give rise to modern otters. Various more advanced otters from the old world Neocene as well as the advanced *Lutra* occurring at Hagerman indicate a more ancient origin for *Lutra*.

Lutravus (?) cookii,[20] new species

Type.—Portion of right ramus of mandible, no. 12606, U. S. Nat. Mus. with P_3 to M_1 inclusive.

Locality.—T. 7 S., R. 13 E., near Hagerman, Idaho.

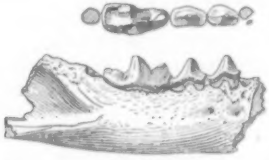

FIG. 2. *Lutravus* (?) *cookii*, new species. Portion of right ramus of mandible with third and fourth premolars and carnassial, type specimen, no. 12606, U.S.N.M., lateral and occlusal views. ×1. Hagerman lake beds, Upper Pliocene, Idaho. Drawing by Sydney Prentice.

Horizon.—Hagerman lake beds.

Specific characters.—Size about two-thirds that of *Lutravus* (?) *idahoensis*, near that of *Martes martes*. Premolars relatively more slender than in *L.* (?) *idahoensis*, but with slight cingulum as in that species. Talonid of lower carnassial relatively a little more elongate than in the larger species.

Description.—The difference in size between *Lutravus* (?) *cookii* and *L.* (?) *idahoensis* appears to be too great to be accounted for by individual variation or sex dimorphism. An isolated lower carnassial referred to *L.* (?) *cookii* is a little larger than in the type of *L.* (?) *cookii* and may represent a male individual. The proportions of the jaw in *L.* (?) *cookii* are similar to those in *L.* (?) *idahoensis* but on a smaller scale. Enough of the mandible anterior to P_3 is preserved to show the alveoli for P_2. The alveolus for the anterior root of P_2 is much smaller and placed directly external to that for the posterior root, having been crowded outward by the canine. The two premolars preserved appear relatively slender in comparison with these two teeth in the larger species, but like the latter each is surrounded by a light, continuous cingulum and is without a posterior accessory cuspule. The carnassial is similar in the two species, the metaconid being prominent and the heel distinctly basined; however, the heel in the case of *L.* (?) *cookii*

[20] Named for Mr. Elmer Cook of Hagerman, Idaho.

is relatively a little longer. There is also a slight external cingulum on the carnassial as seen in some specimens of the larger form.

Lutravus (?) *cookii* is about the size of *Grison canaster*. The preserved portion of the jaw is nearly the same depth and has nearly the same length cheek-tooth row as the type of *Grison canaster*. The thickness of the mandible, however, is very much less in the fossil, the teeth are distinctly more slender and P_2 is apparently not single-rooted. Also, the metaconid of M_1 in *L.* (?) *cookii* is more distinctly set off from the protoconid and the talonid has a larger, more pronounced basin and a narrower hypoconid. *Lutravus* (?)

TABLE 1

Measurements (in millimeters) of mandible and inferior dentition

	LUTRAVUS(?) IDAHOENSIS			LUTRAVUS(?) COOKII
	No. 12030 U.S.N.M. type	No. 12027 U.S.N.M.	No. 12617 U.S.N.M.	No. 12606 U.S.N.M. type
Distance between posterior margin of canine alveolus and posterior margin of coronoid process immediately above condyle			56.6	
Distance from posterior margin of canine alveolus to posterior margin of alveolus for M_2		32.0*	33.5	27.5*
Depth of mandible posterior to P_3	15.0*	14.1	14.5	11.1
Depth of mandible below middle of M_1	15.2	14.3	15.6	
Depth of mandible posterior to M_2	17.2	15.7	16.2	12.4
Thickness of mandible below middle of M_1	7.5	6.3	7.1	5.3
P_3, anteroposterior diameter			6.3	5.3
P_3, greatest transverse diameter			3.7	3.2
P_4, anteroposterior diameter	7.7	7.3		5.8
P_4, greatest transverse diameter	4.4	3.8		3.1
M_1, anteroposterior diameter	14.2	13.3		10.7
M_1, length of trigonid from anterior end of tooth to notch between protoconid and hypoconid	9.9	9.2		7.2
M_1, greatest transverse width of tooth	6.3	5.7		4.6
M_1, width of trigonid anterior to metaconid	5.4	4.8		3.5
M_1, width of talonid	6.0	5.3*		4.5
M_2, anteroposterior diameter	4.6	5.0		
M_2, greatest transverse diameter	4.5	4.3		

* Approximate.

cookii probably did not give rise to *Grison canaster*, presumably the marked specialization reached in the living forms extends farther back than the late Pliocene stage represented at Hagerman.

Satherium,[21] new subgenus

Genotype.—Lutra piscinaria Leidy, Rept. U. S. Geol. Surv. Terr., vol. 1, p. 316, plate 31, fig. 4, 1873.

[21] σάθέριον, an otter.

Subgeneric characters.—Lower jaw elongate with depth below M_1 greater than length of M_1; massseteric fossa deeply excavated. Dental formula: $\frac{3}{?}, \frac{1}{1}, \frac{?}{3}, \frac{?}{2}$. Upper carnassial with anteroposteriorly expanded heel, well developed parasytle and prominent cusp between protocone and anterior part of paracone. Upper and lower canines and lower premolars relatively large. Talonid basin of lower carnassial nearly closed lingually by cuspule (metastylid) immediately posterior to metaconid. Cnemial crest on tibia prominent but outstanding portion relatively short axially.

Lutra (Satherium) piscinaria Leidy

The type of *Lutra piscinaria*, a right tibia, no. 662, U. S. Nat. Mus., was collected by Clarence King at a locality on Sinker Creek, Idaho. Although Pohle,[22] in revising the

FIG. 3

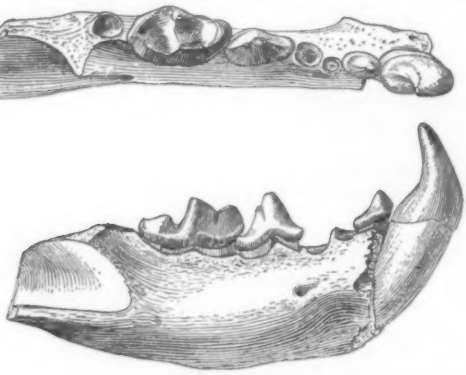

FIG. 4

FIG. 3. *Lutra* (*Satherium*) *piscinaria* Leidy, new subgenus. Upper carnassial, no. 12601, U.S.N.M., lateral and occlusal views. ×1. Hagerman lake beds, Upper Pliocene, Idaho. Drawing by Sydney Prentice.

FIG. 4. *Lutra* (*Satherium*) *piscinaria* Leidy, new subgenus. Right ramus of mandible with canine, second and fourth premolars and carnassial, no. 12601, U.S.N.M., lateral and occlusal views. ×1. Hagerman lake beds, Upper Pliocene, Idaho. Drawing by Sydney Prentice.

Lutrinae, was not inclined to recognize this specimen as belonging to a *Lutra*, it is undoubtedly from an otter-like animal of unusually large size. Compared with tibiae of *Lutra canadensis* the head of the fossil tibia, though incomplete, is relatively broad. The cnemial crest is more robust making the proximal portion of the shaft noticeably deep, although the crest does not continue distally parallel to the axis of the shaft for so great distance as in the modern form. Also, the distal portion of the shaft is relatively wide because of the sharper, more outstanding external ridge for attachment of the interosseous membrane. Leidy's figure[23] of this specimen is not entirely accurate, particularly in details of the distal portion which is more otter-like than indicated in the drawing.

[22] Hermann Pohle, Archiv für Naturgeschichte, Jahrg. 85, Abt. A, Heft 9, pp. 173–174, 1919.

[23] Joseph Leidy, Rept. U. S. Geol. Surv. Terrs., vol. 1, pl. 31, fig. 4, 1873.

Comprising the Hagerman material referred to *Lutra piscinaria* are portions of five mandibles, a few fragments of a skull and several incomplete limb elements. One of the mandibles (fig. 4), no. 12601, U.S.N.M., has portions of both rami preserved and includes the canine and two premolar teeth of the right ramus and the carnassials of both sides. This jaw was found associated with the distal half of a humerus and fragments of a skull which includes two incisors, a canine and the right carnassial tooth (fig. 3). A second lower jaw, no. 12603, U.S.N.M., found in the *Plesippus* quarry, is nearly complete posterior to the canine alveolus and retains P_2 to M_2, inclusive. In the other mandible portions the teeth are absent or poorly preserved. The unassociated limb material includes two fragmentary humeri and the greater portions of two tibiae.

If the above material represents Leidy's form, *Lutra piscinaria*, as appears reasonably probable, further description of the species based on the lower jaw and dentition and on the upper carnassial may be made. Moreover, it appears that the Hagerman form, though closely related to modern *Lutra*, is sufficiently distinct to warrant giving it subgeneric rank, for which the name *Satherium* is proposed.

Specific characters.—Size distinctly larger than *Lutra canadensis*; jaw robust and uniformly deep below cheek-teeth; teeth larger than in *L. canadensis*; P^4, P_4 and M_1 without suggestion of a median external rootlet; upper and lower carnassials relatively wide transversely and anterior surface of paracone on P^4 with steeply sloping profile in lateral view; width of individual teeth in lower premolar series not great as compared with length anteroposteriorly. Tibia robust and elongate; humerus larger and apparently less curved than in *L. canadensis*.

Description.—*Lutra* (*Satherium*) *piscinaria*, although clearly related to the otters, is nevertheless distinct from living species of *Lutra* in a number of important respects. As seen in the Hagerman material the mandible of this species is conspicuously long and deep, the depth being nearly uniform below the cheek-tooth series. The relatively deep jaw, though distinguishing *L.* (*Satherium*) *piscinaria* from true *Lutra*, is a character observed in some of the fossil genera, as *Potamotherium*, *Brachypsalis*, *Sivaonyx* and *Enhydriodon* and to a somewhat less degree in living *Aonyx*. In no. 12603, U.S.N.M., from Hagerman the portion of the jaw posterior to the tooth row is markedly elongate, allowing the deeply excavated masseteric fossa considerable anteroposterior extent. Also, the ascending ramus appears to be directed backward somewhat more than in living otters of North America.

In No. 12601, U.S.N.M., the upper incisors and canine are of large size but do not present any other unusual characters. The upper carnassial is distinctive in possessing a prominent cuspule antero-internal to the paracone[24] and well separated from the protocone. The parastyle is particularly well developed and placed noticeably forward and outward from the base of the paracone. The anterior profile of the paracone in lateral view is more abrupt than is common in *Lutra canadensis*.

The upper carnassial is decidedly modern in its development of the talon or inner basin, which is nearly similar to that in *L. canadensis*. The expanded talon readily distinguishes *Satherium* from forms exhibiting a more abbreviated heel as *Potamotherium*, *Brachypsalis*, *Lutravus*, and *Lutra lutra*. The absence of a distinct hypocone (tetartocone) removes it from the *Vishnuonyx-Sivaonyx-Enhydriodon* group.

The lower premolars, though three in number, are not so reduced individually as in *Lutra canadensis*. The distance between the canine and carnassial is relatively great in the fossil jaws. However, these teeth are proportionally slender, particularly as compared with teeth observed in such forms as *Lutra felina* and *Lutra platensis* from South

[24] Using molar cusp nomenclature this may be called the paracone, but it is apparently the original protocone as determined by Scott (Proc. Acad. Nat. Sci., Philadelphia, pp. 405–444, 1892).

America. An unusually wide P_4 is characteristic of the old world fossil forms *Sivaonyx* and *Enhydriodon*.

The lower carnassial is moderately hypsodont and resembles that of *Lutra canadensis*, in a general way but is relatively wider than is common in the living species. Moreover there is present immediately adjacent and posterior to the metaconid in M_1 a cuspule which does not seem to occur in living species of *Lutra*. This cuspule, apparently a metastylid and not an entoconid as in *Sivaonyx*, *Enhydriodon*, *Aonyx* and *Micraonyx*, is sharply separated from the postero-internal crest of the heel and occupies a position almost closing the talonid basin lingually, causing the deepest part of the basin to be located at a point more inward from the lingual margin of the tooth. This suggests that the hypocone of the upper molar, which occludes with the talonid basin of the lower carnassial, may have been placed inward from the lingual margin of the tooth somewhat more than in *L. canadensis*.

The otter tibiae from Hagerman are slightly smaller than the type tibia of *Lutra piscinaria* but they exhibit the short, heavy cnemial crest characterizing the type, and also show the pronounced external ridge on the distal half of the shaft. Presumably, these outstanding characters of the tibia are of more than either individual or specific importance. Hence, allocation of the Hagerman material to *L. piscinaria* may be open to question until adequate topotype material from the Sinker Creek locality is found.

Comparison of *Lutra* (*Satherium*) *piscinaria* with the type of *Brachypsalis* (?) *pristinus* (Matthew and Gidley)[25] from the Valentine beds of South Dakota shows the mandible of the Idaho form to be of less depth, although not appreciably different in this respect from the lower jaw of *B.* (?) *pristinus*, described from the Upper Snake Creek beds[26] of Nebraska. The length of the tooth row in *B.* (?) *pristinus* is only slightly greater than in *L.* (*S.*) *piscinaria*. The premolars in the two forms are noticeably similar, although a little narrower in *B.* (?) *pristinus*. Moreover, P_4 in *B.* (?) *pristinus* lacks the posterior accessory cuspule characterizing the living otters. This cuspule is not particularly well developed in no. 12601, U.S.N.M., from Hagerman, although more conspicuous in no. 12603. However, important dental characters distinguishing the two species are exhibited in the lower carnassial. The shearing blades of the trigonid in this tooth are more anteroposteriorly directed in *B.* (?) *pristinus* than in *L.* (*S.*) *piscinaria* or than in *Lutra canadensis*, and the tooth is narrower through the protoconid-metaconid region. The talonid is elongate postero-internally more than in the Hagerman species although it is broadly basined as in the latter. M_1 in *B.* (?) *pristinus* does not show a distinct metastylid as this tooth does in *L.* (*S.*) *piscinaria* but the talonid basin is closed on its lingual side by a strong ridge sloping downward and backward from the summit of the metaconid, somewhat as in *Mionictis*. M_2 in the type of *B.* (?) *pristinus*, though circular in outline, is of much larger size than this tooth in *L.* (*S.*) *piscinaria*. The alveolus for M_2 in the Snake Creek specimen is relatively elongate and somewhat constricted in the posterior portion. *B.* (?) *pristinus* is perhaps related to *Satherium*, although the upper carnassial in the portion of an upper dentition referred by Matthew to *B.* (?) *pristinus* differs from P^4 of *L.* (*S.*) *piscinaria* in being of a distinctly more primitive construction. *Brachypsalis modicus* Matthew[27] probably should not be included in the same genus with *B.* (?) *pristinus* as the two mandibles and lower dentitions are distinctly different. The genotype, *Brachypsalis pachycephalus*, from the Upper Miocene of Nebraska was described by Cope[28] on a

[25] W. D. Matthew and J. W. Gidley, Bull. Amer. Mus. Nat. Hist., vol. 20, pp. 256–257, figs. 7–8, 1904.

[26] W. D. Matthew, Bull. Amer. Mus. Nat. Hist., vol. 50, pp. 131–132, fig. 29, 1924.

[27] W. D. Matthew, *ibid.*, vol. 38, pp. 195–196, 1918.

[28] E. D. Cope, Amer. Naturalist, vol. 24, pp. 951–952, 1890.

nearly toothless portion of a mandible, the relationships of which are not clear. Cope regarded his form as related to the otters, as indicated by the talonid portion of the lower carnassial, which appears quite unlike the abbreviated heel of M_1 in *B. modicus*.

Remarks.—The presence of a prominent accessory cuspule in both upper and lower carnassials, as well as the advanced appearance of these teeth, does not favor considering *Satherium* in the direct line of descent of any of the living otters. Contrasted with the specialized structure of the carnassials the fossil is primitive in the elongation of the jaw and the relative length of the premolar series. The dentition is distinctly more advanced than that of *Potamotherium* or of the species referred to *Brachypsalis*, and in the expansion of the talon of P^4 has progressed even farther than in *Lutra lutra*. The European otter possesses a rather primitive dentition, suggesting dispersion of this form from some other center during later Tertiary time. *Satherium* may have been derived from the Lower Pliocene *B.* (?) *pristinus* but it seems more probable that this aberrant group separated from the stem represented by modern *Lutra* at a later date than did *B.*(?) *pristinus*.

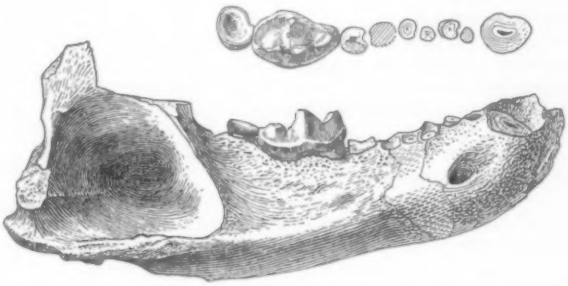

FIG. 5. *Lutra* (*Satherium*) *ingens*, new species. Right ramus of mandible with molar teeth and root portions of canine and premolars, type specimen, no. 1167, Calif. Inst. Technology, Coll. Vert. Paleont., lateral and occlusal views. ×¾. Idaho Formation, Upper Pliocene? Idaho. Drawing by Sydney Prentice.

Lutra (Satherium) ingens, new species

Type.—Most of the right ramus of the mandible and part of the left, with both lower carnassials and right second molar preserved; No. 1167 Calif. Inst. Technology, Coll. Vert. Paleont.

Locality.—Northwest of Grand View, Idaho.

Horizon.—Idaho Formation (?).

Specific characters.—Proportions of mandible considerably greater than in *Lutra* (*S.*) *piscinaria* from near Hagerman. Depth of jaw below teeth increasing greatly toward posterior end of tooth row. Base of coronoid broad anteroposteriorly. Masseteric fossa deep and extensive. Lower portion of surface for attachment of temporal muscle well defined and faced markedly upward. Lower teeth similar to those of the Hagerman species but larger, and M_1 and M_2 relatively wider.

Description.—*Lutra* (*Satherium*) *ingens* is known only from the type mandible, but this specimen is readily distinguished from the Hagerman jaws, identified as *L.* (*S.*) *piscinaria*, by its much greater size. The proportions of the jaw apparently exceed those of the "wing-tailed" otter, *Pteronura brasiliensis*, of South America. As in the Hagerman form the Grand View jaw is relatively elongate with the depth greater than

the length of the first lower molar. The depth of the jaw increases posteriorly below the tooth row more than in the Hagerman specimens, approaching a depth below M_2 nearly one-half greater than in *L.* (*S.*) *piscinaria*. Also, the mandible is considerably thicker, exhibiting a markedly broad ventral surface. The base of the coronoid process is long anteroposteriorly and deflected sharply outward over a deeply impressed masseteric fossa, facing the lower portion of the inner surface for attachment of the temporal muscle more dorsally than in *L.* (*S.*) *piscinaria* or *L. canadensis*. The development of the masseteric

TABLE 2

Measurements (in millimeters) of mandible, superior and inferior dentition, and tibia

	LUTRA (SATHERIUM) PISCINARIA		LUTRA (SATHERIUM) INGENS
	No. 12601 U.S.N.M.	No. 12603 U.S.N.M.	No. 1167 C.I.T. Coll. type
I^2, anteroposterior diameter	3.3		
I^3, greatest transverse diameter	3.5		
I^3, anteroposterior diameter	5.5		
I^3, greatest transverse diameter	3.9		
C, greatest transverse diameter at base of enamel	7.3		
P^4, anteroposterior diameter	15.0		
P^4, greatest transverse diameter	12.3		
Length of mandible from anterior end to posterior margin of coronoid immediately above condyle			107.0
Length of mandible from posterior margin of canine alveolus to median point on posterior surface of condyle		80.0	
Depth of mandible posterior to P_3	18.5	18.5	23.5
Depth of mandible below middle of M_1	18.5	18.5	24.5
Depth of mandible posterior to M_2	20.0	21.2	29.0
Thickness of mandible below middle of M_1	9.0	9.1	12.3
Length of premolar-molar series, P_2 to M_2 incl.	45.0*	45.4	52.5*
Length of premolar series, P_2 to P_4 incl.	24.5	25.4	28.0*
C, anteroposterior diameter at cingulum near base of enamel	11.5		
C, anteroposterior diameter of alveolus			12.5*
C, transverse diameter of alveolus			9.4*
P_2, anteroposterior diameter	6.7	6.7	
P_2, greatest transverse diameter	4.2	4.3	
P_3, anteroposterior diameter		7.8	
P_3, greatest transverse diameter		4.8	
P_4, anteroposterior diameter	10.6	9.6	
P_4, greatest transverse diameter	6.0	5.5	
M_1, anteroposterior diameter	16.5	16.6	18.3
M_1, greatest transverse diameter	9.2	8.8	11.3
M_2, anteroposterior diameter		5.7	7.5
M_2, greatest transverse diameter		6.3	9.0

TABLE 2 (*Continued*)

	LUTRA (SATHERIUM) PISCINARIA		
	No. 662 U.S.N.M. type	No. 12598 U.S.N.M.	No. 12600 U.S.N.M.
Greatest length of tibia	126.0		
Width of proximal end of tibia	32.3*	29.0*	
Depth of proximal end of tibia	23.0*	21.0*	
Length of cnemial crest from anterior margin of proximal surface of head to distal extremity of rugose prominence	43.0*	41.0*	
Greatest diameter of shaft at mid-section	13.2	11.5	12.5
Least diameter of shaft at mid-section	8.7	8.3	8.2
Width of distal end across prominent points	24.2		

* Approximate.

fossa and the scar on the mandible for the temporal muscle indicate a heavy zygomatic arch and strong temporal ridges on the skull, and possibly a marked sagittal crest.

The teeth of *L.* (*S.*) *ingens* are distinctly larger than those of *L.* (*S.*) *piscinaria*, but the premolar series is proportionally long, as in the latter species. M_1 shows essentially the same structure as in the smaller species but is relatively wider, as is M_2. The metastylid on M_1, which characterizes *Satherium*, is prominent in *L.* (*S.*) *ingens*, closing the talonid basin lingually even more completely than in the Hagerman specimens.

The lower carnassial is comparable in size to that of *Pteronura brasiliensis* but is as readily distinguished from the corresponding tooth in that form as it is from M_1 in *Lutra canadensis* in the characters of the talonid. Moreover, the relatively large canine alveolus and elongate premolar series are further differences separating the Grand View form from *Pteronura*.

Aonyx and *Micraonyx*, the finger otters of Africa and Asia, as well as the extinct *Enhydriodon* have an enclosed talonid basin in M_1, but these types have a pronounced postero-internal crest or entoconid, and do not exhibit the prominent metastylid characterizing this tooth in *Satherium*. The entoconid region of M_1 in *L.* (*S.*) *ingens* though somewhat less subdued than in *L.* (*S.*) *piscinaria* does not show the development reached in *Enhydriodon* or the finger otters.

The tibia of *Lutra* (*Satherium*) *ingens* is unknown, consequently direct comparison with the type of *L.* (*S.*) *piscinaria* cannot be made. It is assumed from the greater size and robustness of the mandible of *L.* (*S.*) *ingens* as compared with the Hagerman jaws that the tibia of *L.* (*S.*) *ingens* would be considerably more robust than the Hagerman tibiae, and hence possibly much larger than the type tibia of *Lutra piscinaria*. This reasoning is highly unsatisfactory and it is possible that additional material from the region will show the Grand View form instead of the Hagerman species to be identical to *Lutra piscinaria*, as the geographic relations might suggest.

U. S. National Museum, Washington, D. C.

TWO NEW POCKET GOPHERS (THOMOMYS) FROM SOUTHERN ARIZONA

By William Henry Burt and Berry Campbell

During the past summer (1933) the junior author spent considerable time collecting vertebrates in the mountains of southern Arizona. A series of six pocket gophers taken in the Pajarito Mountains, near the Mexican boundary, during this time was donated to the California Institute of Technology and the senior author has subsequently studied these gophers to determine their relationships with the known gophers of the region. They represent a heretofore unknown race which occupies another of Arizona's small mountain masses. Further study was also made of a series of gophers in the Dickey Collection from the lower edge of the oak belt in the Santa Rita Mountains (see Burt, Journ. Mamm., vol. 14, May, 1933, p. 118). These gophers are here considered to be distinct from the form occurring higher up in the mountains and are accordingly described below.

Thomomys burti quercinus subsp. nov.

Type.—Male adult, skull and skin; no. 51176, collection of California Institute of Techlonogy; Peña Blanca Spring, Pajarito Mountains, Arizona, (near Mexican boundary, north of monument 128); July 15, 1933; collected by Berry Campbell; original no. 2147.

Measurements.—Type: total length, 195 mm.; tail vertebrae, 60; hind foot, 26. Skull: basilar length of Hensel, 31.3; nasals, 12.3; zygomatic breadth, 21.3; mastoid breadth, 17.6; interorbital constriction, 6.3; alveolar length of upper molar series, 7.1; width of rostrum, 7.5; projection of premaxillae posterior to nasals, 3.0. Average skull measurements of three males and three females—Males: Basilar length of Hensel, 31.2; nasals, 12.3; zygomatic breadth, 21.9; mastoid breadth, 17.8; interorbital constriction, 6.5; alveolar length of upper molar series, 7.2; width of rostrum, 7.6; projection of premaxillae posterior to nasals, 2.6. Females: Basilar length of Hensel, 29.4; nasals, 11.0; zygomatic breadth, 20.1; mastoid breadth, 16.8; interorbital constriction, 6.5; alveolar length of upper molar series, 6.9; width of rostrum, 6.7; projections of premaxillae posterior to nasals, 2.6.

Distribution.—Known only from the type locality, but probably ranges throughout the oak belt in the Pajarito Mountains and possibly the Atasco Mountains to the north and west.

Characters.—A small, richly-colored gopher with a distinct dark median dorsal stripe, rounded skull, and three pairs of mammae; males but slightly larger than females. Nearest in morphological characters to *Thomomys burti* Huey from the Santa Rita Mountains, but differs from that race in the following respects: color of sides distinctly paler with a yellowish instead of a deep chestnut cast; dark median dorsal stripe less pronounced and extending only to the rump. Skull differs in slightly larger size; larger interparietal; termination of nasals farther anteriorly with respect to the zygomatic arm of the maxillary, thereby causing a greater extension of the premaxillae posterior to the nasals; pterygoids, as viewed from ventral surface, weaker and V-shaped instead of U-shaped as in *burti*, and lacking the distinct process which projects laterally and ventrally from each wing in *burti*.

Thomomys burti quercinus differs from nearby forms of the *fulvus* group in darker coloration, smaller size, more rounded skull, and three instead of four pairs of mammae.

Remarks.—In the skulls of each of two specimens, both females, there is a distinct naso-frontal fontanelle at the termination of the nasals, a condition not due to age, as they are both fully adult. A similar condition, but in a different part of the skull, is found in certain specimens of *Thomomys scapterus* Elliot from California where there is often a distinct interparietal fontanelle.

Specimens.—Six, three males and three females, all from the type locality.

Thomomys burti proximus subsp. nov.

Type.—Female adult, skull and skin; no. 18947, collection of Donald R. Dickey; Old Parker Ranch (Picketts Ranch on U. S. Geological Survey topographic map, Patagonia Quadrangle, edition of August, 1905), altitude 4800 feet, west slope of Santa Rita Mountains, Pima County, Arizona; June 9, 1931; collected by W. H. Burt; original no. 2878.

Measurements.—Type: total length, 193; tail vertebrae, 61; hind foot, 25. Skull: basilar length of Hensel, 28.8; nasals, 10.8; zygomatic breadth, 20.4; mastoid breadth, 17.7; interorbital constriction, 6.4; alveolar length of upper molar series, 6.8; width of rostrum, 6.9; projection of premaxillae posterior to nasals, 2.6. Average of five adult females, skull measurements: Basilar length of Hensel, 28.9; nasals, 11.3; zygomatic breadth, 20.7; mastoid breadth, 17.4; interorbital constriction, 6.4; alveolar length of upper molar series, 7.2; width of rostrum, 6.9; projection of premaxillae posterior to nasals, 2.4.

Distribution.—Known only from the lower edge of the oak belt (type locality) on the west side of the Santa Rita Mountains, Arizona.

Characters.—Similar to *Thomomys burti burti*, from the higher life zones of the Santa Ritas, in size and skull characters. General color (new pelage) near olive-tawny of Ridgway (Color Standards and Color Nomenclature, 1912); no dark dorsal stripe; black ear patches large and conspicuous. Skull small and rounded, highly arched antero-posteriorly. Mammae in three pairs. Differs from *burti* in slightly greater projection of premaxillae posterior to nasals, absence of dark dorsal stripe, conspicuous dark ear patches, and distinctly paler general coloration. Immature specimens are ashy gray whereas an immature specimen of typical *burti* is nearly as dark as adults of that race. Differs from *quercinus* in absence of dark dorsal stripe, larger and more conspicuous black ear patches, and in skull characters pointed out above as distinguishing *quercinus* from *burti*. Differs from nearby forms of *Thomomys fulvus* in smaller size, more rounded skull, and three instead of four pairs of mammae.

Remarks.—It was pointed out in a previous paper (Burt, Journ. Mamm., vol. 14, May, 1933, p. 118) that a series of gophers from Old Parker Ranch, Santa Rita Mountains, contrasted strikingly with the series from Madera Canyon (described as *T. burti*) but they were then considered as a local variant and not named. Judging from external characters, the two groups seem to be genetically distinct. Inasmuch as there is no overlapping in color, even in young individuals, and the two forms occupy different types of soil with accompanying differences in plant associations we believe we are justified in assigning the two groups to distinct races.

Specimens.—Six adults and two young, all females and all from the type locality.

California Institute of Technology and Johns Hopkins Medical School.

DESCRIPTION OF A NEW SNOWSHOE RABBIT FROM EASTERN OREGON, WITH NOTES ON ITS LIFE HISTORY

By Robert T. Orr

In the summer of 1932, while collecting for the Museum of Vertebrate Zoology in Eastern Oregon and in Idaho, Dr. Alden H. Miller, Dean H. Blanchard and I obtained series of snowshoe rabbits (*Lepus bairdii*) from several critical localities. These, in addition to specimens already in the collection of the museum from Idaho and Washington, and a series from the Seven Devils Mountains of Idaho in the private collection of Ralph Ellis, Jr., to whom acknowledgment is here made for their use, furnished the material upon which the following description is based.

Lepus bairdii oregonus, new subspecies

Type.—Adult female, skin and skull; no. 54887, Museum Vertebrate Zoology; twelve miles south of Canyon City, 5500 feet altitude, Grant County, Oregon; June 25, 1932; collected by Robert T. Orr; original no. 557.

Diagnosis.—Size small; color (in summer pelage) similar to that of *Lepus bairdii bairdii*, but with black rump patch somewhat reduced; skull smaller.

Measurements.—Lepus bairdii oregonus: Averages and extremes of 5 adults (2 males, 3 females) from Grant and Union counties, Oregon: Total length, 447.8 (431–470); tail vertebrae, 46.8 (43–51); hind foot, 135.0 (128–142); ear from crown, 94.8 (92–100); ear from notch, 80.4 (76–85); basilar length (4 averaged), 57.9 (55.5–59.8); zygomatic breadth, 37.4 (36.9–38.0); greatest length of nasals, 30.4 (29.6–31.0); greatest combined breadth of nasals, 15.0 (13.9–15.9); diameter of external auditory meatus (4 averaged), 4.4 (4.0–4.7); breadth of brain case measured from inner side of external auditory meatus (4 averaged), 24.1 (23.9–24.4); alveolar length of upper molar series, 13.5 (13.1–13.8).

Lepus bairdii bairdii: Averages and extremes of 5 adults (4 females, plus 1 skull-only) from north-central Idaho are as follows: Total length (4 averaged), 475.8 (466–486); tail vertebrae (4 averaged), 46.3 (35–52); hind foot (4 averaged), 144.8 (140–152); ear from crown (4 averaged), 97.8 (93–101); basilar length (4 averaged), 61.3 (60.9–61.7); zygomatic breadth (4 averaged), 38.6 (37.6–39.5); greatest length of nasals, 32.5 (32.2–32.8); greatest combined breadth of nasals, 16.8 (15.9–17.3); diameter of external auditory meatus, 5.0 (4.6–5.3); breadth of brain case measured from inner side of external auditory meatus (4 averaged), 25.2 (24.9–25.6); alveolar length of upper molar series, 14.1 (13.2–15.4).

Remarks.—The race *oregonus*, while definitely belonging to the species *bairdii*, shows distinct approach to *Lepus washingtonii* in some characters. Likewise, the territory inhabited by *oregonus* is situated geographically between the areas occupied by the two species, namely *L. washingtonii* of the Cascade Range and *L. bairdii* of the Rocky Mountain region (see Nelson, North Amer. Fauna, no. 29, pp. 105–114, 1909). The Snake River, which serves partly as a State boundary between Oregon and Idaho, is in all probability a barrier between the two geographically adjacent races, *bairdii* and *oregonus*. One adult from the Wallowa Mountains of northeastern Oregon differs in no noticeable respect from topotypes of *oregonus*. On the other hand, a series from west-central Idaho is clearly referable to the race *bairdii*. *Lepus bairdii oregonus* agrees with *L. b. bairdii* in possessing broad postorbital processes, a proportionately large rostrum, and a broad interpterygoid fossa, these characters not being held in common with *Lepus washingtonii*. However, as regards size of skull and degree of inflation of the tympanic bullae, the race

oregonus is somewhat intermediate between the two species. Two specimens examined from the Blue Mountains, Columbia County, Washington, maintain the characters of *oregonus*, in that they possess smaller skulls and smaller tympanic bullae than *Lepus bairdii bairdii*.

In view of the fact that there is very nearly a continuous belt of conifers from the Cascades to the eastern side of the state of Oregon, it seems quite possible that further collecting at critical localities in this area may ultimately demonstrate complete intergradation between *Lepus bairdii* and *Lepus washingtonii*.

Specimens examined.—A total of 7, representing the race *oregonus:* **Washington:** Columbia County: Blue Mountains, 2. **Oregon:** Union County: Catherine Creek, 3500 feet, 7 miles east of Telocaset, 1; Grant County: 12 miles south of Canyon City, 5500 feet, 4.

A total of 14 examined, representing the race *bairdii* from the following localities in Idaho: Bonner County: 5 miles west of Cocolalla, 3500 feet, 2; Clearwater County: 2 miles northeast of Weippe, 3000 feet, 3; Washington County: southwest slope of Cuddy Mountain, 3; Adams County: 3 miles west of Payette Lake, 5400 feet, 1; southwest slope of Smith Mountain, 5400 feet, 3; Valley County: Donnelly, 1; Bannock County: near Pocatello, 1.

LIFE HISTORY NOTES

The following observations were made, unless otherwise indicated, in the Blue Mountains of Oregon, 12 miles south of Canyon City, Grant County, on June 25, 26, and 27, 1932. Here snowshoe rabbits (*Lepus bairdii*) were fairly common.

The place at which our party camped was on the exposed (south) side of a range at an altitude of 5500 feet. At this elevation the timber consisted largely of yellow pine with some undergrowth of *Arctostaphylos* and *Ceanothus velutinus*. The north-facing slopes of the many small side canyons, however, received a minimum of sunlight, which condition was reflected in the vegetation. Yellow pines were lacking in such places, they being replaced by dense stands of fir and western larch, the low branches of these conifers and the many young saplings acting as a dense undercover. Intermingled with these fir and larch thickets were small clearings containing a few fallen logs and a moderate growth of green vegetation consisting mostly of grass and such plants as *Collinsia parviflora*, *Castilleia*, and *Lupinus*. Aspens grew sparingly in almost all these open places, as occasionally did *Ribes* and *Ceanothus*.

Snowshoe rabbits were actually seen only in these dense thickets and in the small clearings. Their presence was also indicated in such places by numerous droppings which were sometimes noted on fallen logs and stumps, the tops of which measured at times as high as two feet above the ground.

From observation the writer concluded that members of this species are most often seen in the morning and evening, being similar in this respect to brush rabbits and many other members of the genus *Sylvilagus*. One individual was sitting in erect posture on its hind feet with the fore legs hanging down in front of the body, but not touching the ground; the ears were elevated vertically. In the case of another the hind feet were conspicuous as the animal bounded over fallen logs; when it was sitting quietly, the white rims of hair on the ears were the most prominent markings. The rabbits were seen to feed on *Lupinus* and *Collinsia*.

A total of five individuals with certainty (3 females and 2 males), and possibly six, were noted in a fir-larch area, which was only 100 yards in length and about one-half that distance in width, and more or less isolated from any other such type of growth by at least 150 yards. Presumably this area supported at least this number of rabbits; it seemed improbable that individuals would regularly traverse the more or less open stretches which were timbered with yellow pine.

On June 28, 1932, in the Wallowa Mountains, 7 miles east of Telocaset, Union County, Oregon, signs of snowshoe rabbits were seen near the brush which lined the banks of Catherine Creek. One individual was noted at 7:20 p.m. and again at dusk, in a clearing next to a dense growth consisting of alder and service-berry with a few firs intermingled. At a slight disturbance the animal ran to this cover.

Both the females taken on June 25 had enlarged mammary glands and gave evidence of having recently borne young. The male taken on the same date had much enlarged testes. The female shot on June 26 contained five embryos which averaged 16 mm. in length.

Museum of Vertebrate Zoology, University of California, Berkeley, California.

GENERAL NOTES

NEW GENERIC NAMES FOR TWO SOUTH AMERICAN MARSUPIALS

Notodelphys Thomas, Ann. Mag. Nat. Hist., 1921, (9), VIII, pp. 136–139, with type *N. halli*, is a homonym (Art. 34, Int. Rules Zool. Nomencl.) of the copepod *Notodelphys* Allman, Ann. Mag. Nat. Hist., 1847, (1) XX, p. 2, and of the batrachian *Notodelphys* Lichtenstein and Weinland, Monatsber. k. preuss. Akad. Wiss., Berlin, 1854, p. 373, July. I suggest therefore the name *Lestodelphys* to replace *Notodelphys* Thomas. The full name of the genotype will now stand as *Lestodelphys halli* (Thomas).

The combination *Lesto-* (Gr. = a robber) is used on account of the relatively massive skull and wide strong jaws of this opossum, which lead to the assumption that the animal has predaceous habits.

Orolestes Thomas (Smiths. Misc. Coll., LXVIII, No. 4, p. 3, 1917), with genotype *Orolestes inca*, is found to be a homonym of a genus of dragonflies, *Orolestes* MacLachlan (Ann. Mag. Nat. Hist., ser. 6, vol. 16, p. 21, 1895). To replace the preoccupied generic name I propose *Cryptolestes* (κρυπτός, hidden; λῃστής, robber). The full name of the genotype will now stand as *Cryptolestes inca* (Thomas).

It has seemed desirable to repeat the root *-lestes* on account of its association with the names *Caenolestes* and *Orolestes* and the family name Caenolestidae, about which an extensive literature has grown up.—G. H. H. Tate, *The American Museum of Natural History, New York, N. Y.*

HABITS OF CRYPTOTIS PARVA IN NEW YORK

Five years ago the writer recorded (Journ. Mamm., vol. 9, no. 4, p. 334) the capture of a specimen of *Cryptotis parva* on the campus of Cornell University. This apparently constituted the first published record of the animal from central New York, and to my knowledge, the second record for the state.

On March 17, 1933, Mr. Ed. Drake caught three shrews of this species in a field adjoining his home, three miles east of Ithaca, N. Y. All were found in a nest composed of dry grass, about four inches below the surface of the ground, and were dug out by a small dog. Drake captured the three animals in his hand and put them in a twelve-quart pail, from which two subsequently escaped. The pail had been used to carry wet cement, and the residue, when dry and caked, had formed a rough enough surface to permit the shrews to climb out. Drake's familiarity with the small mammals of the region made him realize he had captured a "find," so he wisely killed the remaining shrew and brought it to me.

That night I set fifty traps within as many yards of the place of Drake's discovery. Because of heavy snow the catch resulted in but two *Blarina brevicauda* and these were both taken in a hedgerow that bordered the field. The next night nine *Blarina*, a deer

mouse, and a meadow mouse, together with a *Cryptotis*, were collected. All but the last named were taken in the hedgerow. The small shrew was taken approximately fifty feet from the point of original capture, and proved to be a male, like the first.

Trapping was continued as opportunity permitted until April 5, when a third *Cryptotis* was taken by Drake's dog. The shrew was dug from a nest of leaves, about five inches under ground, and within thirty yards of the first nest. This was a female, and contained five 6 mm. embryos.

The two males measured 77, 16, 10.5 and 76, 16, 10, respectively, and their weights were 4.4 grams and 4.6 grams. The female measured 86, 19, 11.5 and weighed 5.1 grams. One shrew had a number of fleas, *Doratopsylla blarinae*.

Stomach analysis of the three shrews proved them to feed on much the same type of food as *Blarina*. Fragments of small earthworms, remains of adult beetles, and parts of a centipede, together with much finely comminuted insect remains, constituted the bulk of the food eaten.

Diligent trapping in the immediate neighborhood for more than a month afterward, failed to bring others to light. The habitat was an open field, grown up to red clover, sheep sorrel, and plantain. The area in which the small shrews were taken had been planted to sweet corn the previous season.

On November 30, 1933, Mr. Leo Murray cought five of these little shrews in a shallow nest of rootlets and grass under a heavy slab of rock. The animals were all huddled together in a ball, and were easily captured. One died shortly after capture, but the remaining four are doing very well, feeding freely on scraps of meat and oatmeal flakes. They appear to be more active by night than during the day.

The finding of two nests with three and five occupants each argues for their tolerance of one another, a situation that is not generally accredited to shrews. In both instances the animals all appear to be fully adult.

Unquestionably this species is widespread, though it appears to be rather local in distribution. Possibly the reason for such a paucity of records of its occurrence in a state as well known to mammalogists as New York is that collectors seldom look for small mammals in places like those chosen by *Cryptotis*.—W. J. Hamilton, Jr., *Cornell University, Ithaca, N. Y.*

SOREX MELANOGENYS HALL, A SYNONYM OF SOREX VAGRANS MONTICOLA MERRIAM

Under date of November 9, 1933, in correspondence relative to Arizona-taken mammals borrowed from the Museum of Vertebrate Zoology, E. A. Goldman informed the writer that: "The specimen [of shrew] from the Graham Mountains he [Dr. H. H. T. Jackson] regards as *Sorex vagrans monticola*." A reëxamination, by Dr. S. B. Benson and the writer, of this and the one other specimen constituting the basis for the name *Sorex melanogenys* Hall (Journ. Mammalogy, vol. 13, p. 260, August 9, 1932) and comparison with recently acquired specimens of *Sorex leucogenys* and *Sorex vagrans monticola* convince me that Dr. Jackson's determination is altogether correct and that I was in error.

It is true that in each of the two specimens of *Sorex melanogenys* the third unicuspid, viewed laterally, has a greater anteroposterior length, relative to the fourth unicuspid, than in any other specimen of *Sorex vagrans monticola* I have examined. However, this difference I now believe to be only an individual variation. Certainly, as I now see it, the two specimens are not members of the *Sorex merriami* group of shrews as was originally stated. Therefore, *Sorex melanogenys* Hall should be placed in the synonymy of *Sorex monticolus* Merriam (North Amer. Fauna, no. 3, p. 43, September 11, 1890).—E. Raymond Hall, *Museum of Vertebrate Zoology, University of California, Berkeley, California.*

NOTES ON LONG ISLAND, NEW YORK, BATS

We know of very little bat collecting or study having been done on Long Island since Murphy and Nichols discussed the bats in 1913 (Brooklyn Mus. Sci. Bull., II). At that time there was no record of the occurrence of the little long-eared brown bat (*Myotis keenii septentrionalis*) there, and nothing definite as to the presence of the silvery-haired bat through the summer.

This summer we gave some attention to collecting bats at Mastic, on the south shore near Moriches Bay, with deciduous woodland, and stands of large trees separating more or less overgrown fields. As opportunity offered in the twilight, bats were shot over open ground, usually close to the trees. The little brown bat (*Myotis lucifugus*) was the most plentiful, usually flying along the tree line, and frequently quite low, but very difficult to shoot. An occasional red bat (*Lasiurus borealis*) was among them, but more easily collected. Four of the latter were taken from July 3 to August 7. We wish to place the following data on record as an addition to our knowledge of the local status of these animals.

Myotis keenii septentrionalis (Trouessart). One caught in a house on the evening of August 18. Its ear measured 13 mm. and had a long narrow tragus. The identification was confirmed at the American Museum of Natural History by Messrs. G. G. Goodwin and T. D. Carter.

Lasionycteris noctivagans (Le Conte). Specimens collected on the evenings of June 17 (2), June 25, 28, July 10. The specimens of June 17 were females carrying well developed embryos. All were flying high, those in June in a northerly, the last in a southerly direction. It was a surprise to find this species here in June, although it is commonly observed at the period of southward migration, especially feeding near and over water.

Eptesicus fuscus (Beauvois). One was collected on the evening of August 4. This is one of the commonest bats near New York City, and has been observed on the north shore near Oyster Bay, but we had never previously known of it in this part of Long Island. However, as neither this big brown nor the silvery-haired bats collected were seen under sufficiently favorable conditions to have been identified at sight, both may be regular enough and both may have escaped notice.—D. G. Nichols and J. T. Nichols, *New York City.*

THE OCCURRENCE OF MYOTIS GRISESCENS IN FLORIDA

Among a number of specimens of bats presented to me by Mr. O. C. Van Hyning, the collector, are two skins with skulls of *Myotis grisescens* Howell. These were taken June 9, 1930, while they were flying over the Chipola River in Jackson County, north of Marianna, Florida. While this locality is about 200 miles south of Anniston, Alabama, the southernmost record for this species given by Miller and Allen (U. S. Nat. Mus., Bulletin 144, 1928, p. 83) it is similar to other localities where this bat has been taken, in that limestone caves are available.—H. B. Sherman, *Department of Biology, University of Florida, Gainesville.*

INCREASE OF BADGERS IN NORTHWESTERN OHIO

Unlike most states, Ohio contains no large areas unfit for agriculture. In every part of the state most of the land was cleared long ago. Within its boundaries bears, deer, porcupines, and probably other mammals have long been extinct. To those who are aware of this it may seem strange to hear that badgers still persist in Ohio and that in recent years they have been increasing in numbers.

Like foxes and moles, badgers may live a long time in a region where a great majority of the residents never observe them until they have been captured or killed. In

thickly settled regions badgers are strictly nocturnal. Their burrows are in sand and the ground in Ohio does not freeze deep enough to make it possible to drown them out by pouring water into their burrows, as is done in early spring in Canada.

Where badgers occur in Ohio the belief that they are grave robbers has been rather common and still persists. In a letter written to me in 1919 by a former commissioner of Wood County he tells of a badger "which was captured in a wolf trap, about 1882, in the Perry Township cemetery, after it had been visiting around in the cemetery for about eighteen months." His informant told him that he had seen ribbons and human hair which had been dug out of the graves, and that, so far as he knew, the animal had not burrowed in the ground at any other place in the neighborhood. This badger was sold to a man who took it around from town to town, exhibiting it as the *"Wood County Grave Robber,"* and charging an admission fee to see it. Later its skin was mounted and displayed along with other curious specimens in a beer garden in Tiffin, Ohio.

The association of Ohio badgers with cemeteries may be understood if we reflect that any burrowing animal, unless it is aquatic, naturally prefers as a home for itself and its young a dry site rather than one subject to inundation. In Northwestern Ohio most of the land is so flat that only by an extensive system of tile drains and ditches was it made fit for agriculture. Here and there are low knolls or ridges of sand and many of these were appropriated by the early settlers for burying grounds. These sandy elevations were also attractive to the badgers, for in them they could make homes which would not be flooded in every rainy season.

I now have data for nearly 70 badgers caught or killed in ten counties of Northwestern Ohio. About half of these badgers were found in the last six years. Besides these I have learned of about ten badger burrows which have been observed within this period. The larger number recorded in recent years is due partly to my having recently made more effort to learn of the occurrence of these animals in Ohio. To some extent it may be due to the larger number of men who, because they were unemployed, have spent time in hunting and trapping or working in the woods. But it is probably due also to an actual increase of badgers. Men living in various parts of the territory now occupied by badgers are quite sure that these animals were not formerly found in their neighborhoods, or not in such numbers as in recent years.

Will Ingalls, who has long lived in Fulton County, Ohio, south of Morenci, Michigan, is confident that these animals are increasing there. A neighbor of Mr. Ingalls told me he knew of about six badger burrows within about a mile of his home. He had recently shot a young badger. His father, born nearby, never knew of any badgers in the neighborhood when he was a boy.

In another part of Fulton County is the home of one of my students, Gerald Ernst, who has supplied me data regarding eleven badgers killed in that county, 1928–1933, eight of which he learned about through a fur dealer, who told him that badgers had been increasing the last few years. A letter from this fur dealer, E. C. Windisch, says: "The first badger brought to me was in 1887; about the fourth year after that I bought my second badger, but they were not very plentiful at that time. As prices got better, and during war time, fur was higher and the hunters began to hunt them for the fur and then I bought perhaps three or four a winter, and one or two every winter until this winter when I must have bought at least eight badgers. They have been more numerous in extreme northern Ohio and southern Michigan."

Seymour Holloway was with me when we found badger tracks at the mouth of a burrow in the Oak Openings, in Lucas County. He has sent me data of four badgers caught in that region within the past three years. His father has lived there most of his life. When he was a boy, some sixty years ago, he knew of only one badger anywhere in that region. He walked quite a distance to see that one, after it had been

killed. His father was always interested in such things and would have known of other badgers when he was young had they not been much rarer then than now.

Referring to my letter to the Defiance Crescent-News, a reader wrote to the paper in regard to four badgers caught in traps in Defiance County within the past three years, one of them by a man of fifty-nine years' experience as a hunter and trapper who had never encountered badger "trace" until three years ago.

Sherman Turritin of Evansport, close to the north line of Defiance County, told me, October 22, 1933, that there was a badger in that region some forty years ago, but none since until four or five years ago, since which time four or five of these animals have been caught within three miles of his home.

Near West Unity, in the eastern part of Williams County, M. T. Beatty has lived since 1855. He never knew of these animals in Ohio until about 1918, or a little later, when tracks of a badger attracted much attention. Efforts to catch it were futile for months, but later it was captured. His sons buy fur and have been getting one or two badger skins each winter of late years. They think that badgers are still increasing.

Until recently I never heard of badgers having been seen so far southeast as Huron County, Ohio. I have been informed that in January, 1930, two were found three miles south and west of Willard, "the first badgers any one ever knew of that were seen around Willard." There is a later report of one still farther east in that county.

In December, 1933, I received a report of a badger's being trapped near Mount Victory, about 80 miles south of Toledo.

The increase of badgers in Ohio is probably due partly to the clearing and draining of the land, affording more places for their homes, partly to the increase of thirteen-lined spermophiles and other rodents on which they feed, partly also to the low price of fur making less incentive to kill them.—E. L. Moseley, *Bowling Green, Ohio.*

MOTHER WOLF CARRIES FOOD TWELVE MILES TO HER YOUNG

"The following observation of Ranger Lee Swisher in the Toklat region of Mount McKinley National Park affords valuable data on the range and home life of the Mount McKinley timber wolf (*Canis pambasileus* Elliot) and is here given in essentially his own language in letters of October 16 and November 21, 1933.

"Last spring [1933] I found several mountain sheep killed in Polychrome Pass and with my binoculars saw an old wolf carrying meat from there, going north down the Toklat River. I spent over a week trying to follow her trail and at last found her den and pups on a small island in the Toklat River, about three miles below the last hills of the north range. I judged the distance that she carried the meat to her pups was more than twelve miles.

In locating their dens I find that a pair of wolves cover from 100 to 150 square miles of territory while foraging for their young. . . . The largest pack that I have seen here was eleven, but their usual number is from five to eight during the winter. . . . It seems that they take their intended kill by surprise. Last winter I compared the distance, in feet, of bounds made by an old ram and the wolf that caught him. For a short distance their leaps were approximately the same (about sixteen feet). When the old ram struck a patch of ice he lost out in a few jumps. . . . I have not yet seen where wolves chased their victims more than two hundred yards."—Joseph S. Dixon, *Wild Life Division, U. S. Office of National Parks, Buildings and Reservations, Berkeley, California.*

SEEDS OF THE EUCALYPTUS TREE A NEW FOOD FOR THE ANTHONY GRAY SQUIRREL

The Anthony gray squirrel (*Sciurus griseus anthonyi*) has been a common mammal about my home in South Pasadena, California, for the past several years. An adjoining three acre estate with a number of large oaks and a row of tall eucalyptus (*Eucalyptus*

globulus) next to my property has served as a suitable habitat for the squirrels. Some years ago, while cleaning up the leaves from beneath the eucalyptus trees, branches of which hang over into my yard, I was surprised to find that many of the fruits or ovary capsules had been chewed to small pieces. Upon close examination of these fruits I found that none of the outer pulpy part or the more fibrous woody section had been eaten, but the small seeds were missing from the inside. To me the fruit tasted very strong of eucalyptus oil, was bitter, and left a decided pucker in my mouth. My interest being aroused I kept a rather close watch on the trees and one morning, soon after, I saw several gray squirrels gathering the fruits from the ends of the slender branches, an act which required some degree of dexterity. The fruits were then taken to more substantial perches where they were torn into small bits. Field glasses were of no avail in trying to discern the exact part of the fruit that the squirrels were eating. However, the fruit capsules were gathered up as the squirrels let them fall from the tree and they proved to be in the same condition as those previously picked up. Under one particular tree the capsules were gnawed only on their distal ends, this apparently gave the squirrels quick access to the four seed chambers. The other capsules had all been gnawed from the stem end, an apparently less efficient method of obtaining the small seeds within. The squirrels were seen feeding rather consistently in the eucalyptus trees during the latter part of February and early March, after the stamens and pistils had dropped off and before the capsule caps had split and allowed the seeds and accompanying reddish chaff to fall out. It was quite evident that the squirrels were after the small black seeds contained within the capsule. These seeds are flat and somewhat irregular in outline and have a diameter of from one to two millimeters.

The eucalyptus tree, introduced into California some years ago, has now become well established over much of the natural geographic range of the Anthony gray squirrel and may be expected to produce a substantial portion of the regular diet of that species. The squirrel has not only acquired a predilection for a new food, but has developed a method of attack quite different from any method that I have seen described for native Australian mammals. Le Souef, Burrell, and Troughton, in their recent book on the wild animals of Australia, state that when the eucalyptus trees are in blossom the big Gould fruit bat (*Pteropus gouldi*) comes in flocks to feed on the flowers while the greater flying phalanger feeds on the leaves and buds of the tree.—LUTHER LITTLE, *South Pasadena, California.*

SUBGENERIC ALLOCATION OF THE WHITE-FOOTED MOUSE, PEROMYSCUS SLEVINI, FROM THE GULF OF CALIFORNIA, MEXICO

The white-footed mouse that inhabits Santa Catalina Island in the Gulf of California, Mexico, was discovered in 1921 by the California Academy of Sciences Expedition to the Gulf. At that time one specimen, an adult male, was taken on the island by a member of the party. Joseph Mailliard, of the California Academy of Sciences, sent the specimen to Dr. E. W. Nelson who turned it over to E. A. Goldman for study. Goldman concluded that the specimen represented an undescribed species which belonged to the subgenus *Haplomylomys* and that *Peromyscus californicus* was its nearest relative. Mailliard accordingly described the specimen as representing a new species which he called *Peromyscus slevini* and placed it in the subgenus *Haplomylomys* (Proc. Calif. Acad. Sci., ser. 4, vol. 12, July 22, 1924, p. 1221).

No additional specimens of *Peromyscus slevini* were taken until December 14 and 15, 1931, at which time I had the opportunity to collect 52 specimens, 25 males and 27 females, on Catalina Island. While attempting to discern the true relationships of the various species of mice found on the islands in the Gulf of California it became evident, from the large series of *slevini* at hand, that this species was not a member of the sub-

genus *Haplomylomys*, but, instead, of the subgenus *Peromyscus* as defined by Osgood in his revision of the genus (North Amer. Fauna, no. 28, 1909, p. 32). The distinguishing characters as given by Osgood (*ibid.*) in his key to the subgenera of the genus *Peromyscus* are as follows:

c. Two principal outer angles of M^1 and M^2 with more or less well-developed accessory tubercles or enamel loops . . . ; mammae 3/3 (i. 2/2, a. 0/0, p. 1/1) . . . . . *Peromyscus.*

cc. Two principal outer angles of M^1 and M^2 simple, without accessory cusps or enamel loops or with rudimentary ones . . . ; mammae 2/2 (i. 2/2, a. 0/0, p. 0/0) . . . . . *Haplomylomys.*

In regard to the first character, that of the accessory cusps or enamel loops, all of the specimens of *P. slevini* have a distinct accessory cusp or enamel loop in the second upper molar; however, this is variable in the first upper molar, where it is usually present but small. In the second character, number of mammae, *slevini* with its three pairs of mammae of course agrees with members of the subgenus *Peromyscus* and not *Haplomylomys*. Futhermore, the soles of the hind feet are hairy and not naked or nearly so and the general outline of the skull is more like that of *Peromyscus maniculatus* than that of *P. californicus*. Except for its large size I can see no close resemblance between *slevini* and *californicus*. The baculum, a structure that apparently possesses diagnostic characters, but has been neglected by taxonomists, shows no close relationship between *slevini* and *californicus*.

Peromyscus slevini seems to be an aberrant type that has no doubt been derived from some mainland species of the subgenus *Peromyscus*. Apparently because of its plasticity and restricted area of occupation, it has changed to such an extent that its real specific consanguinity is masked by the morphological characters that it has now developed.—William Henry Burt, *California Institute of Technology, Pasadena, California.*

AN IMPROVED PEROMYSCUS RATION

Considerable changes have been made in the last few years in the mouse ration previously described in this Journal.[1] As now prepared the ration is considerably higher than before in protein content, and is also somewhat more diversified by the addition of several kinds of seeds. The ingredients are combined in the following proportions by weight:

Rolled oats	53	Sunflower seed	1.5
Dry meat scraps	20	Hemp seed	1
Dry skim milk	10	Canary seed	1
Whole wheat	5	Millet seed	1
Wheat germ	5	Iodine salt	0.5
Cod-liver oil	2		100 0

In mixing the ration the cod-liver oil is first well stirred into a small portion of the rolled oats; then all the ingredients are mixed together in a barrel churn. The mesh of the wire screen is too small in most of the food hoppers in the cages to allow the sunflower seed to pass, and usually this item is fed separately, once in two weeks or more frequently. In addition to the dry food ration, lettuce trimmings are fed twice weekly, as much in each cage as the mice will eat up promptly.

No claim is made that this ration is perfect. Its composition is largely empirical, although an effort has been made to include all the known vitamins and other needed

[1] Journ. Mammalogy, vol. 10, p. 121, 1929.

food elements. With this ration I have had very good success in breeding some refractory kinds of *Peromyscus*; and most species and races have been exceptionally fertile. Nevertheless, a few forms still fail to breed.—Lee R. Dice, *University of Michigan, Ann Arbor, Michigan.*

REDISCOVERY OF DIPODOMYS NITRATOIDES EXILIS

With the occupancy of a region by the white man and its cultivation and irrigation, many animals are not able to hold their own. Those classed as game, as the elk and antelope, are either killed, or their range is reduced so that they cannot exist. In the case of some of the burrowing animals, they are not able to maintain their systems of underground burrows. The latter is the case with the kangaroo rat in the arid southwest.

Fresno, California, the type locality of *Dipodomys nitratoides exilis*, is the center of a large agricultural district, part of which is under irrigation and part dry-farming grain lands. This kangaroo rat was described and named by C. Hart Merriam in 1891, from a specimen collected by Vernon Bailey. Other specimens were collected in 1894 by Clark P. Streator. In preparation of his paper, "A Geographical Study of the Kangaroo Rats of California" (University of California Press, 1922), Dr. Grinnell made special efforts to obtain topotypes of all the forms in the state, but no specimens of *D. n. exilis* were obtained. Other efforts to obtain new specimens have failed, so that this subspecies was supposed to have been exterminated by the cultivation of the area.

It seemed probable to the writer that there were several chances that this animal could still be found. The range might be greater than previously thought; or, during the gradual advance of agriculture to the west of Fresno, the species might have advanced and occupied a new region; or, the species might have been driven into a concentration in an undetermined original area. It was decided, therefore, to make a systematic search on all the margins adjacent to the cultivated area. The first trapping was done on September 16, 1933, immediately south of the town of Kerman, Fresno County, California. The elevation is 210 feet, the life zone, Lower Sonoran. Burrows of two sizes were found over this area and kangaroo rats of two sizes were taken. The larger species proved to be *Dipodomys heermanni tularensis*, while the smaller has been identified as *Dipodomys nitratoides exilis*. Identification has been made by the Bureau of Biological Survey at Washington and by the Museum of Vertebrate Zoology at Berkeley.

Dipodomys nitratoides exilis belongs to the *merriami* group, which includes some of the smallest of the genus *Dipodomys*. The original description states that it is similar to *D. merriami merriami*; it has been shown, however, to be nearer to *D. nitratoides nitratoides*, both in characters and in geographic range. The range of *merriami* is to the southeast and across the mountains; that of *nitratoides* is in the southern part of the San Joaquin valley, while that of *exilis* is in the immediate vicinity of Fresno. The color of *exilis* is described as darker than that of *nitratoides*, with heavier black across the nose, and black on the posterior aspect of the ankles; this holds as far as the specimens examined are concerned. The specimens of *exilis* that were compared with specimens of *nitratoides* were taken at different times of the year. The question of the differences in color due to alkali might be considered. Specimens of *exilis* have been taken on alkali areas where the crust of alkali was thick enough to crack when walked upon; these are the same color as some taken where the alkali was much less evident. Specimens of *D. heermanni tularensis* taken in the alkali area are much lighter in color. Comparison in size of *exilis* and *nitratoides* is as follows: Average of ten *exilis* (measurements in millimeters): Total length, 226; tail vertebrae, 133; hind foot, 33;

ear 9.6; weight 33.5 grams. Average of ten *nitratoides* as given by Dr. Grinnell, as cited above: Total length 233; tail vertebrae, 139; hind foot, 35; ear, 9.8; weight 36.6 grams. Skull measurements of *exilis* are uniformly smaller.

Associated with *D. nitratoides exilis* is a larger species of kangaroo rat, *D. heermanni tularensis*. In this species the hind foot measures 41 mm. and there are five toes on the hind foot; *exilis* has four toes on the hind foot.

Systematic collecting southward from the Fresno area should determine finally the relation between *exilis* and *nitratoides*.—A. E. CULBERTSON, *Fresno State College, Fresno, California.*

A FIVE LEGGED RABBIT

An adult male rabbit (*Sylvilagus floridanus mearnsii*) taken at Ore Lake, Livingston Co., Michigan, on November 28, 1932, was presented to the Division of Mammals, Museum of Zoology, University of Michigan, by William Corsan. This rabbit, which is fat and weighs 2 pounds, is apparently normal except for an extra hind leg and innominate bone.

The pubis of the extra appendage is attached by connective tissue to the normal pubis, posteriorly, barely to one side of the median symphysis, in such manner as to permit a swinging movement. The extra innominate is malformed and is approxi-

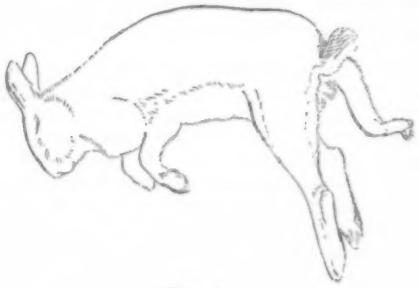

FIG. 1

mately one-half the length of the normal bone. The extra leg is atrophied but with proportions practically the same as in the normal leg. The normal femur measured 93 mm., the extra femur 74 mm.; the normal tibia 108 mm., the extra tibia 83 mm. The extra foot was mangled by the trap which caught the rabbit, so could not be measured. The leg muscles of the extra leg are very small, probably because of disuse. The color of the fur is similar to that of the normal leg but is darker and lacks some of the white on the inner side. The joints are all functional but movement is limited, because of the shortened muscles and shrunken skin.

If natural selection operated rigorously in nature, this rabbit, handicapped by an extra leg dangling between its hind legs, should have fallen prey to its enemies early in life. Possibly under present day ecological conditions in Livingston County the pressure of natural foes on the rabbit population has decreased, thus weakening natural selection and permitting the unfit to survive with the fit. However, natural selection probably operates on populations rather than on individuals, so that even under primitive conditions a handicapped animal might escape its direct pressure and survive to maturity.—ADOLPH MURIE, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

RECENT LITERATURE

Bailey, Vernon. CAVE LIFE OF KENTUCKY, MAINLY IN THE MAMMOTH CAVE REGION. The University Press, Notre Dame, Indiana; pp. 256, figs. 8, 1933. (Reprinted from the American Midland Naturalist, vol. 14, no. 5, pp. 385–635, 1933.)

This handy little volume provides an authoritative and timely guide to the animal life of Mammoth Cave and its immediate vicinity. The mammal part of the report occupies 53 pages, with 13 illustrations. Forty-five species are treated in Mr. Bailey's pleasing style, with emphasis primarily on the habits of the animals. The 12 species of bats known from the region are given somewhat fuller treatment than the other mammals, and there is a key to the species, all of which should prove helpful to visitors desiring to learn to know these interesting cave dwellers.

The value of the book is greatly enhanced by a chapter on "Some of the Birds of the Mammoth Cave Region" (112 pages, 95 species, 60 figures) by Florence Merriam Bailey, and by shorter papers on the fishes, the reptiles, and the amphibians by Mr. Bailey, and on the invertebrates, by Leonard Giovannoli.—ARTHUR H. HOWELL.

Townsend, M. T., and M. W. Smith. WHITE-TAILED DEER OF THE ADIRONDACKS. Bulletin of the Roosevelt Wild Life Experiment Station, vol. 6, no. 2, New York State College of Forestry, Syracuse, October, 1933.

The white-tailed deer and the cottontail rabbit are two game species of which it may be said that they are important everywhere, but so far studied nowhere. Any new contribution to the ecology of either is, therefore, a welcome addition to the literature of conservation.

This new bulletin on the white-tail appears in the sumptuous format usual to the Roosevelt bulletins. One is disappointed, however, after noting its wealth of illustration and maps, to find no index. There is a good bibliography.

Part I contains the summer field observation of the two authors during a three-year period, and includes some genuinely new material, including a description of the curious but as yet unexplained habit of "grubbing" by deer in search of rootlets, bulbs, or possibly of chemical substances. The habit of eating algae is another newly observed peculiarity.

Following the usual estimates of population density, the authors forge ahead of precedent and give us an analysis of the composition of the deer herd by sex and age classes. (It may be remarked here that most of the big game statistics so far in print are useless to the game manager because yearlings are not differentiated. The present authors have happily avoided this mistake.)

The winter habits of the deer are sketched briefly by compilation of previous authors, but it is notable that the western writers (such as Dixon, Hall, Locke, Robinson, Goldman, Ligon, Musgrave), as well as the work of the Michigan Conservation Department (Lovejoy, Bartlett, and Stephenson) are ignored. The western work, of course, has dealt principally with species other than the white-tail, but is nevertheless pertinent to the subject in hand.

The concluding chapter, by Charles J. Spiker, covering winter observations in the Adirondack region, shows a somewhat surer touch. Spiker analyzes winter mortality by sex and age, and throws new light on the sequence in which the various sex and age classes succumb to adverse winter conditions. He describes a healthy buck that was unable to arise from smooth ice and hence had perished—a form of accident hitherto unknown to me. He apparently disagrees with Townsend and Smith on the comparative palatability of conifers, especially on the question of whether balsam is an emergency or staple winter browse. A number of alleged deaths from pneumonia in deer yards are passed over without a guess as to what might have caused the pneumonia.

This is regrettable, because it has been current talk among game managers for several years that the pneumonic condition in deer may be induced by parasites, food poisoning, or other causes.

In general, I am left with the impression that here is a valuable piece of work which all game managers must keep at hand for ready reference, but it carries an air of intellectual isolation which should not obtain in so firmly-rooted an institution as the Roosevelt Station.—ALDO LEOPOLD.

AMSCHLER, WOLFGANG. Über das Vorkommen der letzten Wisente im Kauskasus und in der Mongolei. Züchtungskunde, vol. 5, no. 4, pp. 157–160, figs. 3. April, 1930.

ANDERSON, C. The skull of *Sthenurus occidentalis* Glauert. Records Australian Mus., vol. 18, no. 7, pp. 383–387, figs. 1–6, pls. 45, 46. June 21, 1932.

ANDREWS, ROY CHAPMAN. The fate of the rash Platybelodon. Nat. Hist., New York, vol. 31, no. 2, pp. 115–128, figs. 18. March–April, 1931.

(ANONYMOUS.) Australia's only big game. Migratory buffalo. Field, London, vol. 161, no. 4184, p. 413, illus. March 4, 1933.

ANTHONY, R. La théorie dentaire de la "multituberculie." Revue anthropologique, Paris, année 43, nos. 1–3, pp. 95–101. January–March, 1933.

ARAMBOURG, C. Révision des ours fossiles de l'Afrique du Nord. Ann. Mus. d'Hist. Nat. Marseille, vol. 25, pp. 249–299, pls. 1–6. 1933.

[AYLMER], E. A. *Muntiacus lacrymans*, the barking deer or muntjac. Hong Kong Nat., vol. 3, no. 1, pp. 69–70, pls. 12, 13. March, 1932.

BARCLAY, EDGAR N. The lechwe of South-Central Africa. Ann. & Mag. Nat. Hist., London, ser. 10, vol. 11, no. 63, pp. 334–339. March, 1933. (*Kobus leche* Gray =*K. smithemani* Lydk., *K. robertsi* Roths.)

BENCHLEY, BELLE J. Mbongo and Ngagi. Two gorillas who live far from their native mountains. Nature Mag., vol. 21, no. 5, pp. 217–222, illus. May, 1933.

BENSON, SETH B. Description of a race of the Mexican vole, *Microtus mexicanus*, from southeastern Utah. Proc. Biol. Soc. Washington, vol. 47, pp. 49–50. February 9, 1934. (New: *Microtus mexicanus navaho*.)

BERLIOZ, J. L'élevage et l'hybridation du bison au Canada. Bull. Soc. Nat. Acclimat. France, vol. 80, no. 2, pp. 47–53. February, 1933.

BIERENS DE HAAN, J. A. Die Baukunst eines niederen Affen (*Cebus hypoleucus* Humb.). Tijdschr. Nederland. Dierk. Vereen, vol. 2, no. 1, pp. 23–27, pl. 1. 1930.

———. Über das sogenannte "Waschen" des Waschbären (*Procyon lotor*), nebst einigen Bemerkungen über die Formen und die Bedeutung der tierischen Spiele. Biol. Zentralbl., vol. 52, no. 6, pp. 329–343. 1932.

BIGALKE, R. Anatomical studies, no. 37: On a hybrid duiker. Union S. Africa, Dept. Agric., Dir. Vet. Serv. and Animal Indust. Rept., no. 18, pt. 2, pp. 1093–1094, fig. 1. August, 1932.

BIRULA, A. A preliminary report on the rodents from the Quaternary deposits of Crimea. Comptes Rendus Acad. Sci. URSS, ser. A, 1930, no. 23, pp. 617–622, 1930. (In Russian.)

BODE, FRANCIS D. Characters useful in determining the position of individual teeth in the permanent cheek-tooth series of merychippine horses. Bull. Geol. Soc. America, vol. 43, no. 1, pp. 287–288. March, 1932. (Abstract.)

———. Anchitheriine horses from the Merychippus zone, North Coalinga District, California. Bull. Geol. Soc. America, vol. 44, no. 1, p. 219. February 28, 1933. (Abstract.)

Bogert, Chas. M. Notes on porcupines of the Grand Canyon region. Grand Canyon Nat. Notes, vol. 8, no. 1, p. 137–140. April, 1933.

Bolam, George. Some random observations on bats. Northwestern Nat. (Scotland), vol. 8, no. 1, pp. 33–36. March, 1933.

Botar, J. Note sur le mode de terminaison du pneumogastrique antérieur chez quelques mammifères. Bull. Mus. Nat. Hist. Nat. Paris, ser. 2, vol. 5, no. 4, pp. 269–276, figs. 1–7. April, 1933.

Braestrup, F. W. On the taxonomic value of the subgenus Lophomops (Nyctinomine bats) with remarks on the breeding times of African bats. Ann. & Mag. Nat. Hist., London, ser. 10, vol. 11, no. 63, pp. 269–274. March, 1933.

Bressou, C. L'isard et sa protection dans les Pyrénées françaises. Bull. Soc. Nat. Acclimat. France, vol. 80, no. 3, pp. 79–89. March, 1933. (Rupicapra.)

Brink, F. H. van den. Observations mammalogiques dans les Pays-Bas. I. Tijdschr. Nederland. Dierk. Vereen., vol. 2, no. 1, pp. 43–46. 1930.

Case, E. C. A specimen of a long-nosed dolphin from the Bone Valley gravels of Polk County, Florida. Contrib. Mus. Paleont., Univ. Michigan, vol. 4, no. 6, pp. 105–113, pls. 2. January 15, 1934. (New: *Schizodelphis bobengi*.)

Castle, W. E., and C. E. Keeler. Blood group inheritance in the rabbit. Proc. Nat. Acad. Sci., vol. 19, pp. 92–98. January, 1933.

———. Tests for linkage between the blood-group genes and other known genes of the rabbit. Proc. Nat. Acad. Sci., vol. 19, pp. 98–100. January, 1933.

Champion, F. W. Preservation of wild life in the United Provinces of India. Field, London, vol. 161, no. 4185, pp. 478–479, illus. March 11, 1933.

Chapman, Frank M. A home-making bat. Nat. Hist., New York, vol. 32, no. 6, p. 555, fig. 2. November–December, 1932. (*Artibeus watsoni* making tent-like shelter by cutting leaves of palm with its teeth.)

Chappellier, A. Les rongeurs de France et la lutte contre les rongeurs nuisibles. Archiv. d'Hist. Nat., Soc. Nat. d'Acclimat. France, Paris, 1–138, figs. 49, pls. 4, tables 3. 1932.

Clark, Herbert C., and Lawrence H. Dunn. Experimental efforts to transfer monkey malaria to man. Amer. Journ. Tropical Med., vol. 11, no. 1, pp. 1–10. January, 1931.

Clarke, C. H. Douglas. Some field notes on the abundance of small mammals. Canadian Field-Nat., vol. 47, no. 4, pp. 73–74. April, 1933.

Colbert, Edwin H. The skull of *Dissopsalis carnifex* Pilgrim, a Miocene creodont from India. Amer. Mus. Novitates no. 603, pp. 8, figs. 4. March 28, 1933.

———. The skull and mandible of Conohyus, a primitive suid from the Siwalik beds of India. Amer. Mus. Novitates no. 621, pp. 12, figs. 5. May 13, 1933.

Coolidge, H. J., Jr. Notes on a family of breeding gibbons. Human Biol., vol. 5, no. 2, pp. 288–294, figs. 4. May, 1933. (*Hylobates concolor leucogenys*.)

Coomans de Ruiter, L. De koeboeng (*Galeopithecus volans* L.). Tropische Natuur, vol. 19, no. 1, pp. 15–16, fig. 1. January, 1930.

———. Het javaansche Schubdier (*Manis javanica* Desm.). Tropische Natuur, vol. 19, nos. 5–6, pp. 100–102, figs. 2. 1930.

De la Croix, Paul Magne. La locomación prebipedal del niña. Physis., vol. 11, no. 38, pp. 114–120. 1932.

Depéret, Ch. Dolichopithecus arvernensis Depéret. Nouveau singe du Pliocène supérieur de Sénèze (Hte-Loire). Trav. Lab. Géol. Fac. Sci. Lyon, vol. 15, no. 12, pp. 1–12, portrait and pl. 1. 1929.

Deraniyagala, P. E. P. Fight between a cobra and a mongoose. Spolia Zeylanica, Ceylon Journ. Sci., vol. 17, pt. 1, pp. 53–55, pls. 9, 10. October 11, 1932.

Dice, Lee R. The prairie deer-mouse. Bull. 2, Cranbrook Inst. Sci. (Bloomfield Hills, Mich.), pp. 8, pls. 5. November, 1932.

Ditmars, Raymond L. Thrills of a naturalist's quest. Macmillan Co., New York: pp. xii + 268, frontispiece, figs. 48. 1932. Price, $3.50.

Doctor, Silver. Cougar in Vancouver Island. Field, London, vol. 159, no. 4124, p. 51, fig. 1. January 9, 1932.

Duff, John F. Leopard shot near Kuling [Kiangsu]. China Journ., vol. 18, no. 2, p. 109. February, 1933.

Dukelskaja, N. W. Biology of mole-rat (*Spalax microphthalmus* Güld.) and experiments on different methods of its control. Bull. Plant Protection, Leningrad, The Lenin Acad. Agric. Sci. in U. S. S. R., ser. 4, no. 2, pp. 23–45, figs. 7. 1932. (Russian text with English summary.)

Edinger, Tilly. Über jungdiluviale Säugetiere aus dem Emschergebiet. Palaeont. Zeitschr., Berlin, vol. 13, nos. 1–2, pp. 119–133, figs. 9. May 31, 1931.

———. Diluviale Ovibos von Mühlheim-Ruhr. Centralblatt f. Min., etc., Jahrg. 1931, Abt. B, no. 3, pp. 136–143, figs. 7. 1931.

———. Die Konkrement-Steine der Wirbeltiere als potentielle Fossilien. Geol. Rundschau, vol. 23a, Salomon-Calvi-Festschrift, pp. 248–256, figs. 6. 1933.

Ehrenberg, Kurt. Über die letzten Ergebnisse der Windener Grabungen und einige Probleme der Diluvial-Paläontologie. Verhandl. Zool.-Bot. Ges. Wien, Jahrgang 1932, vol. 82, nos. 1–4, [appendix] pp. 41–51. 1932.

Elton, Charles. The Canadian snowshoe rabbit enquiry, 1931–32. The Canadian Field-Nat., vol. 47, no. 4, pp. 63–69. April, 1933; vol. 47, no. 5, pp. 84–86. May, 1933.

Engels, William L. Notes on the mammals of St. Joseph County, Indiana. Amer. Midland Nat., Notre Dame, Ind., vol. 14, no. 1, pp. 1–16, figs. 3. January, 1933.

Figgins, J. D. The bison of the western area of the Mississippi basin. Proc. Colorado Mus. Nat. Hist., vol. 12, no. 4, pp. 16–33, pls. 9. December 5, 1933. (New: *Stelabison* for *Bison occidentalis*, *Stelabison occidentalis francisi*, *Bison oliverhayi*, *Bison angularis*, *Bison rotundus*, *Bison bison septemtrionalis*, *Bison bison haningtoni*.)

Finley, William L. Mammals on the mountain tops. Murrelet, vol. 14, no. 1, pp. 9–12. January, 1933.

Fisher, A. K. Cats, licenses, hunters and conservation. National Humane Rev., vol. 21, no. 4, p. 4. April, 1933.

Fleay, David. Swainson's Phascogale (the "Bush Mouse"). Victorian Naturalist, vol. 49, no. 5. pp. 132–134, fig. 1. September, 1932.

Flerov, K. K. Zur Biologie der Säugetiere des Nördlichen Urals und Westsibiriens. Bull. Acad. Sci. URSS, Cl. sci. math. et nat., 1933, pp. 445–470, figs. 12, pls. 2. 1933.

Flintoff, R. J. Stoats and weasels—brown and white. Northwestern Nat. (Arbroath, Scotland), vol. 8, no. 1, pp. 36–45. March, 1933.

Formosof, A. N. The crop of cedar nuts, invasions into Europe of the Siberian nutcracker (*Nucifraga caryocatactes macrorhynchus* Brehm) and fluctuations of the squirrel (*Sciurus vulgaris* L.). Journ. Anim. Ecology, vol. 2, no. 1, pp. 70–81, figs. 1–3. May, 1933. (When the crop of Siberian cedar nuts fails the nutcrackers wander into Europe in search of food and the squirrel population becomes reduced by starvation.)

Fraipont, Charles. Anthropologie et mutations. Revue anthropologique, Paris, année 43, nos. 1–3, pp. 37–43, fig. January–March, 1933.

FRECHKOP, SERGE. Notes sur les mammifères. XIII. Note préliminaire sur la similitude des molaires supérieures et inférieures. Bull. Mus. Roy. d'Hist. Nat. Belgique, Bruxelles, vol. 9, no. 7, pp. 11, figs. 6. March, 1933.

———. Notes sur les mammifères. XIV. Du système vasculaire de la vésicule blastodermique, de certains caractères structuraux et de l'origine des Monotrèmes. Bull. Mus. Roy. d'Hist. Nat. Belgique, Bruxelles, vol. 9, no. 8, pp. 13, figs. April, 1933.

FRIANT, M. A propos de la dentition d'un représentant Eocene du groupe des Tubulidentata. Bull. Mus. Nat. Hist. Nat. Paris, ser. 2, vol. 5, no. 2, pp. 101–103, figs. 1– 2. February, 1933.

———. Contribution a l'étude de la différenciation des dents jugales chez les mammifères. Essai d'une théorie de la dentition. Publ. Mus. Nat. Hist. Nat. Paris, no. 1, pp. v–ix, 1–132, figs. 71. 1933.

FRY, D. H., JR. Rare whale taken at San Pedro. Calif. Fish & Game, vol. 19, no. 2, p. 158. April, 1933. (*Balaenoptera davidsoni*.)

FURLONG, E. L. A new otter from later Cenozoic beds, Southwestern Idaho. Bull. Geol. Soc. America, vol. 44, no. 1, p. 219. February 28, 1933. (Abstract. Not named.)

GAZIN, C. LEWIS. Miocene mammalian fauna from Southeastern Oregon. Bull. Geol. Soc. America, vol. 42, no. 1, p. 367. March, 1931. (Abstract.)

GILMORE, CHARLES W. Fifty thousand years on ice. Nature Mag., vol. 21, no. 1, p. 30, illus. January, 1933. (Mammoth.)

GILTAY, LOUIS. Observations tératologiques sur des squelettes du genre Elephas. Bull. Mus. Roy. d'Hist. Nat. Belgique, vol. 9, no. 11, pp. 7, figs. 6. April, 1933.

GLAESSNER, MARTIN F. Neue Zähne von Menschenaffen aus dem Miozän des Wiener Beckens. Ann. Naturhist. Mus. Wien, vol. 46, pp. 15–27, pl. 2. 1933.

GOLDMAN, E. A. A new climbing mouse from Panama. Journ. Washington Acad. Sci., vol. 23, no. 11, pp. 525–526. November 15, 1933. (New: *Oecomys endersi*.)

GOODWIN, GEORGE G. A new species of shrew from eastern Siberia. Amer. Mus. Novitates no. 657, pp. 2. September 8, 1933. (New: *Sorex gravesi*.)

GRANT, MADISON. The vanished game of yesterday. Reprint from the Boone and Crockett Club book "Hunting Trails on Three Continents." The Derrydale Press, Inc., New York, pp. 22, figs. 2. 1933.

GRAY, ROBERT W. Peterhead sealers and whalers. A contribution to the history of the whaling industry. Scottish Nat., no. 197, pp. 129–133; September–October, 1932; no. 198, pp. 157–162, November–December, 1932; no. 199, pp. 1–10, January–February, 1933; no. 200, pp. 33–38, March–April, 1933; no. 202, pp. 97–104, July–August, 1933; no. 203, pp. 129–138, September–October, 1933.

GREEN, ARDA A., and ALFRED C. REDFIELD. On the respiratory function of the blood of the porpoise. Biol. Bull., vol. 64, no. 1, pp. 44–52. February, 1933.

GREEN, C. V. A genetic craniometric study of two species of mice and their hybrids. Journ. Exper. Zool., vol. 63, no. 2, pp. 533–551, figs. 1–7. October 5, 1932. (*Mus musculus* and *M. bactrianus*.)

GROMOV, V. I. Sur l'âge du Paléolithique de Sibérie. Comptes Rendus Acad. Sci. URSS, ser. A, no. 10, pp. 171–176. 1928. (In Russian.)

GRUBER-THALMANN, GABRIELE. Gorillaschädel vom Likouala. Ann. Naturhist. Mus. Wien, vol. 46, pp. 165–183, pls. 8–11. 1933.

GUDGER, E. W. Bullets and spear-heads embedded in the tusks of elephants. Sci. Monthly, vol. 35, no. 4, pp. 312–327, figs. 15. October, 1932.

HACHISUKA, M. A naturalist's visit to the Parc National Albert, Belgian Congo. Natural History Mag. (British Mus.), vol. 4, no. 25, pp. 20–30, illus. January, 1933. (Photographs of gorilla nests.)

HALL, E. RAYMOND, and WILLIAM B. DAVIS. Notes on Arizona rodents. Proc. Biol. Soc. Washington, vol. 47, pp. 51–56. February 9, 1934. (New: *Thomomys bottae trumbullensis.*)

HAMILTON, J. E. The southern sea-lion. Natural History Mag., (British Mus.) vol. 4, no. 26, pp. 56–66, figs. 1–9. April, 1933. (*Otaria byronia.*)

HARTMAN, CARL G. Ovulation and the transport and viability of ova and sperm in the female genital tract. Chapter XIV of "Sex and Internal Secretions," pp. 647–733, figs. 17. 1932.

———. Book review: The social life of monkeys and apes, by S. Zuckerman. Anat. Record, vol. 54, no. 1, pp. 129–133. September, 1932.

———. Pelvic (rectal) palpation of the female monkey, with special reference to the ascertainment of ovulation time. Amer. Journ. Obstetrics and Gynecology, vol. 26, no. 4, pp. 600–608, figs. 5. October, 1933.

HATT, ROBERT T. Jerboas, kangaroo rats and jumping mice. Nat. Hist., vol. 33, no. 2, p. 199–208. March–April, 1933.

HAUSMAN, LEON AUGUSTUS. The "ovate bodies" of the hair of Nothrotherium shastense. Amer. Journ. Sci., ser. 5, vol. 18, no. 106, pp. 331–333, figs. 3. October, 1929.

HECK, H. Beobachtungen bei der Elefantenzucht. Naturforscher, vol. 9, no. 11, pp. 401–404, pl. 85. February, 1933.

HELLER, E. Elephants in and out of the zoo. Bull. Washington Park Zool. Soc., Milwaukee, vol. 4, no. 1, pp. 18. May, 1933. (Contains records of elephants bred in captivity, physical characters of three species, and comments on some well known individuals.)

HELLER, FLORIAN. Ein Milchgebiss von Lophiodon munieri Filhol aus der eozänen braunkohle des Geiseltales bei Halle-Saale. Nova Acta Abhandl. Kaiserl. Leop.-Carol. Deutsch. Akad. Naturforscher, vol. 1, no. 1, pp. 47–53, pls. 2. 1932.

———. Lophiodon munieri Filh. aus der eozänen Braunkohle des Geiseltales bei Halle-Saale. Nova Acta Abh. Kaiserl. Leop.-Carol. Deutsch. Akad. Naturforscher, vol. 1, no. 1, pp. 37–45, pls. 3. 1932.

HEPTNER, WL. G. Notizen über die Gerbillidae (Mammalia, Rodentia). VI. Zool. Anzeiger, vol. 102, nos. 3–4, pp. 107–112. March 10, 1933. (New subfamilies: *Merioninae* and *Rhombomyinae.*)

HILL, W. C. OSMAN. The external characters of the bonnet monkeys of India and Ceylon. Spolia Zeylanica, Ceylon Journ. Sci., vol. 16, pt. 3, pp. 311–322, pl. 65. March 18, 1932.

———. Albinism in Ceylon macaques. Spolia Zeylanica, Ceylon Journ. Sci., vol. 17, pt. 3, pp. 248–250, pl. 39. May 19, 1933.

———. A monograph on the genus Loris. With an account of the external, cranial and dental characters of the genus: a revision of the known forms; and the description of a new form from Northern Ceylon. Ceylon Journ. Sci., sect. B, Zool. & Geol., vol. 18, pt. 1, pp. 89–132, figs. 8, pls. 7–11. December 22, 1933. (New: *Loris tardigradus nordicus.*)

HILZHEIMER, MAX. Dogs. Antiquity, vol. 6, no. 24, pp. 411–419, pls. 1–12. December, 1932.

HODGE, EDWIN T. New evidence of the age of the John Day formation. Bull. Geol. Soc. America, vol. 43, no. 3, pp. 695–702. September 30, 1932.

HOFFER, WILHELM. Zoogeographische Studien am jagdbaren Wilde Steiermarks. Mitteil. Naturwiss. Ver. Steiermark, vol. 68, pp. 51–82, 8 maps. 1931.

HOLMAN, JOHN P. Sheep and bear trails. A hunter's wanderings in Alaska and British Columbia. Frank Walters, Grand Central Palace, New York, pp. xvi + 211, pls. 43. 1933.

HOLMES, S. J. A forgotten evolutionist. Science, n.s., vol. 77, no. 1985, pp. 48–49. January 13, 1933. (D. Schelver in 1802 commented on the origin and original cradle of the human race.)

HUGUES, ALBERT. Les invasions de sangliers dans le midi de la France. Bull. Soc. Nat. Acclimat. France, vol. 79, no. 10, pp. 449–461. October, 1932.

———. Un ragondin au Grau-du-Roi (Gard). Bull. Soc. Nat. Acclimat. France, vol. 79, no. 10, p. 486. October, 1932. (*Myocastor.*)

———. La souris des jardins et les campagnols aquatiques. Bull. Soc. Nat. Acclimat. France, vol. 80, no. 1, pp. 3–8. January, 1933.

HUTCHINSON, W. I. Destruction of wild life in the Matilija fire [California]. Calif. Fish & Game, vol. 19, no. 2, p. 126–128. April, 1933.

JENKS, A. E. Minnesota Pleistocene Homo. Science, vol. 76, no. 1980, pp. 546–547. December 9, 1932. (Abstract.)

JEPSEN, GLENN L. American eusmiloid sabre-tooth cats of the Oligocene epoch. Proc. Amer. Philos. Soc., vol. 72, no. 5, pp. 355–369, pls. 4. 1933.

JOLEAUD, L. Le magot de berbérie. Bull. Soc. Nat. Acclimat. France, vol. 78, no. 5, pp. 153–155. May, 1931.

KEELER, CLYDE E. In quest of Apollo's sacred white mice. Sci. Monthly, vol. 34, no. 1, pp. 48–53, figs. 3. January, 1932.

KELLOGG, REMINGTON. A new cetothere from the Modelo formation at Los Angeles, California. Contrib. Palaeont. Carnegie Inst. Washington, Publ. 447, pp. 83–104, figs. 3, pl. 1. January 10, 1934. (New: *Mixocetus*, *M. elysius.*)

———. The Patagonian fossil whalebone whale, Cetotherium moreni (Lydekker). Contrib. Palaeont. Carnegie Inst. Washington, Publ. 447, pp. 63–81, figs. 2, pls 4. January 10, 1934. (New: *Aglaocetus* for *Cetotherium moreni* Lydekker.)

KELLY, G. LOMBARD. Simple test for pregnancy using immature female albino rats. Journ. Amer. Medical Assoc., vol. 100, no. 13, pp. 1010–1013, figs. 2. April 1, 1933. (Intraperitoneal injection of urine from pregnant women causes solution of vaginal closure in immature white rats.)

KENDEIGH, S. CHARLES. A study of Merriam's temperature laws. Wilson Bull., vol. 44, no. 3, pp. 129–143, figs. 2. 1932.

KLEMOLA, V. The "pied" and "splashed white" patterns in horses and ponies. Journ. Heredity, vol. 24, no. 2, pp. 65–69, figs. 4. February, 1933.

KLÜVER, HEINRICH. (Introduction by K. S. LASHLEY.) Behavior mechanisms in monkeys. Univ. Chicago Press, pp. xi + 387, 52 figs. April, 1933.

KOCH, W. Grundlagen der Fütterungslehre für Sumpfbiberzüchter. Der Deutsche Pelztierzüchter, Müchen, 8 Jahrgang, 1933, no. 3, pp. 51–55, fig. 3. February, 1933. (Good photographs of skull and digestive tract of *Myocastor.*)

KRISHNA AYYAR, P. N. Notes on some rats damaging crops in South India. Proc. Indian Sci. Congr., vol. 17, p. 60. 1930. (An abstract.)

LANE, H. H. Variation in Palaeosyops. Univ. Kansas Sci. Bull., vol. 20, nos. 7–21, pt. 2, pp. 319–326. 1932.

LA NOUE, FRANCIS D. A one act play of nature. Yellowstone Nat. Notes, vol. 10, nos. 1–2, p. 2. January–February, 1933. (Coyote chasing deer.)

LAURIE, ALEC H. Some aspects of respiration in blue and fin whales. Discovery Reports, Cambridge, England, vol. 7, pp. 363–406, figs. 4, pl. 15. 1933.

LEROUX, P. L. A new nematode (*Rictularia aethechini*, sp. nov.) a Physaloptera and an Acanthocephala from the hedgehog (*Aethechinus frontalis*). 16th Report Director Veterinary Serv. & Anim. Industry, Union S. Africa, pp. 217–227, figs. 18. August, 1930.

LEROUX, P. L. On *Longistrongylus meyeri* gen. and sp. nov., a trichostrongyle parasitizing the red hartebeest *Bubalis caama*. Journ. Helminthology, vol. 9, no. 3, pp. 141–146, figs. 3. July, 1931.

———. A preliminary note on *Bilharzia margrebowiei*. a new parasite of ruminants and possibly of man in Northern Rhodesia. Journ. Helminthology, vol. 11, no. 1, pp. 57–62. January, 1933.

———. On *Tenuostrongylus cynictis*, gen. et sp. n., a trichostrongylid parasitizing the yellow Mungoose (*Cynictis penicillata*). Ann. & Mag. Nat. Hist., ser. 10, vol. 11, pp. 222–228, figs. 7. February, 1933.

LINDEKAM, OTTO. Chinchillas und Chinchillafelle. Der Deutsche Pelztierzüchter, München, 8 Jahrgang, 1933, no. 8, pp. 169–175, fig. 5. April 15, 1933. (Bibliography, classification, and photographs.)

LOCKE, S. B. Studies of feeding habits of mule deer in the intermountain region. Trans. Amer. Game Conf., vol. 18, pp. 262–266. (1931) 1932.

M—, R. Importation of thar and chamois into New Zealand. Field, London, vol. 161, no. 4180, p. 200. February 4, 1933.

MACCURDY, GEORGE GRANT. Prehistoric research in the Near East. Proc. Amer. Philos. Soc., vol. 72, no. 3, pp. 121–135, figs. 1–12. 1933. (Human skeletons from Palestine.)

MATTHEW, W. D. Critical observation on the phylogeny of the rhinoceroses. Bull. Geol. Soc. America, vol. 42, no. 1, pp. 366–367. March, 1931. (Abstract.)

MCARTHUR, J. M. Chipmunk vs. snake. Canadian Field-Nat., vol. 47, no. 4, p. 76. April, 1933.

MCCANN, CHARLES. Notes on the colouration and habits of the white-browed gibbon or hoolock (*Hylobates hoolock* Harl.). Journ. Bombay Nat. Hist. Soc., vol. 36, no. 2, pp. 395–405, pls. 2. April 15, 1933.

MICHAELIS, RICHARD. Mountain sheep in Yosemite. Yosemite Nature Notes, vol. 12, no. 2, p. 13. February, 1933.

MILLER, GEORGE W. Buffalo disposal. Yellowstone Nat. Notes, vol. 10, nos. 1–2, pp. 5–6. January–February, 1933.

MILLER, GERRIT S., JR. The origin of the ferret. Scottish Naturalist, no. 203, pp. 153–154. September–October, 1933.

———. The groups and names of macaques. Chapter 1 (pp. 1–9) of: The Anatomy of the Rhesus Monkey (19 contributors, pp. ix + 383, illus.), edited by Carl G. Hartman and William L. Straus, Jr. Baltimore: The Williams & Wilkins Co. December 1, 1933. Price $6.00.

———. A new monkey from Dutch northeast Borneo. Proc. Biol. Soc. Washington, vol. 47, pp. 15–18. February 9, 1934. (New: *Presbytis canicrus*.)

MITTELHOLZER, WALTER. Lion hunting in Tanganyika. Field, London, vol. 159, no. 4123, pp. 4–6, figs. 3. January 2, 1932.

MOHR, ERNA. Alarik Behm zugeeignet das Waldross der Insel Gotland. Zool. Garten, Leipzig, n.F., vol. 6, nos. 4–6, pp. 83–96, figs. 13. 1933.

MORI, TAMEZO. On two new bats from Corea. Journ. Chosen Nat. Hist. Soc., no. 16, pp. 4–5. July 31, 1933. (New: *Rhinolophus quelpartis*, *Murina hilgendorfi intermedia*.)

NACHTSHEIM, H. Gibt es Leporiden? Der Deutsche Pelztierzüchter, München, 8 Jahrgang, 1933, no. 3, pp. 69–72. February 1, 1933. (Hybrids between rabbit and hare probably mythical.)

NAGASAWA, JÔJI. Fossil Père David's Milou deer from province of Harima. Journ. Geol. Soc. Tôkyô, vol. 40, no. 475, pp. 210–212, fig. 1. April 20, 1933. (In Japanese.)

NELSON, E. W., and E. A. GOLDMAN. A new puma from Brazil. Journ. Washington Acad. Sci., vol. 23, no. 11, pp. 523–525. November 15, 1933. (New: *Felis concolor borbensis*.)

NEUVILLE, H. Seconde note préliminaire sur l'organisation du pied des Elephants. Bull. Mus. Nat. Hist. Nat. Paris, ser. 2, vol. 5, no. 1, pp. 63–67, figs. 1, 2. January, 1933.

OBOLENSKIĬ, S. I. A plan for the study of terrestrial vertebrates in the USSR to be carried out by plant protection institutions. Bull. Plant Protection, vol. 4, no. 1, pp. 95–101. 1931. (In Russian, with English summary.)

———. Quantitative studies of rodents in the USSR. Bull. Plant Protection, vol. 4, no. 1, pp. 85–93. 1931. (In Russian, with English summary.)

———. The present knowledge of ground squirrels in the USSR. Bull. Plant Protection, vol. 4, no. 1, pp. 65–72. 1931. (In Russian, with English summary.)

OSBORN, HENRY FAIRFIELD. Biological inductions from the evolution of the Proboscidea. Science, n.s., vol. 76, no. 1979, pp. 501–502. December 2, 1932; Proc. Nat. Acad. Sci., vol. 19, no. 1, pp. 159–163. January, 1933.

———. Recent revivals of Darwinism. Science, n.s., vol. 77, no. 1991, pp. 199–202. February 24, 1933.

OSGOOD, WILFRED H. The South American mice referred to Microryzomys and Thallomyscus. Zool. Ser. Field Mus. Nat. Hist., vol. 20, pp. 1–8. December 11, 1933. (New: *Oryzomys* (*Microryzomys*) *minutus altissimus*.)

———. Two new rodents from Argentina. Zool. Ser. Field Mus. Nat. Hist., vol. 20, pp. 11–14. December 11, 1933. (New: *Thomasomys pictipes*, *Hesperomys bimaculatus bonariensis*.)

PACKARD, EARL L., and REMINGTON KELLOGG A new cetothere from the Miocene Astoria formation of Newport, Oregon. Contrib. Palaeont. Carnegie Inst. Washington Publ. 447, pp. 1–62, figs. 24, pls. 3. January 10, 1934. (New: *Cophocetus*, *C. oregonensis*.)

PEACOCK, E. H. Where 500 elephants are caught in a year. Little-known facts about the wild herds of Burma. Field, London, vol. 161, no. 4181, pp. 252–253, illus. February 11, 1933.

———. Conserving wild life in Burma. Field, London, vol. 161, no. 4187, pp. 616–617, illus. March 25, 1933.

PETRI, B. Sibirische Elche. Naturforscher, vol. 9, no. 12, pp. 458–461. March, 1933.

PHILLIPS, W. W. A. Additions to the fauna of Ceylon, no. 1. Two new rodents from the hills of Central Ceylon. Spolia Zeylanica, Ceylon Journ. Sci., vol. 16, pt. 3, pp. 323–327. March 18, 1932. (New: *Rattus montanus*, *Leggadilla fernandoni*.)

———. Additions to the fauna of Ceylon. No. 2. Some new and interesting bats, from the hills of the Central Province. Spolia Zeylanica, Ceylon Journ. Sci., vol. 16, pt. 3, pp. 329–335, pl. 66. March 18, 1932. (New: *Murina eileenae*, *Kerivoula malpasi*, *Chaerephon plicatus insularis*.)

———. Survey of the distribution of mammals in Ceylon. Spolia Zeylanica, Ceylon Journ. Sci., vol. 16, pt. 3, pp. 337–351. March 18, 1932.

PILGRIM, GUY E. The genera Trochictis, Enhydrictis, and Trocharion, with remarks on the taxonomy of the Mustelidae. Proc. Zool. Soc. London, pt. 4, pp. 845–867, fig. 1, pls. 2. January 6, 1933.

———. A fossil skunk from Samos. Amer. Mus. Novitates no. 663, pp. 1–15, figs. 6. September 27, 1933. (New: *Promephitis majori*.)

PIJATER-PLOKHOZKIJ, K. A. Contributions to the study of the biology of the chipmunk (*Eutamias asiaticus* Gm.) in the Pacific Province. Bull. Plant Protection, Lenin Acad. Agric. Sci., vol. 4, no. 2, pp. 47–53. 1932. (In Russian, with English summary.)

PLATT, MARGERY I. Notes on the skull of an ancient ox from Rousay, Orkney. Scottish Nat., no. 199, pp. 17–24. January–February, 1933.

POCOCK, R. I. Panthers of the north-west frontier. Journ. Bombay Nat. Hist. Soc., vol. 36, no. 2, pp. 489–490. April 15, 1933.

———. The civet cats of Asia. Part 2. Journ. Bombay Nat. Hist. Soc., vol. 36, no. 3, pp. 629–656, fig. 5. August 15, 1933. (New: *Viverricula indica mayori, V. i. wellsi, V. i. baptistae, V. i. klossi.*)

PRESNALL, C. C. A day on snowshoes. Yosemite Nat. Notes, vol. 12, no. 3, pp. 22,–23. March, 1933. (Animals and birds seen along the trail in Yosemite National Park.)

PRIESNER, A. Gibt es Kreuzungen zwischen Fuchs und Hund? Der Deutsche Pelztierzüchter, München, 8 Jahrgang, 1933, no. 6, pp. 131–134, figs. 2. March 15, 1933. (Apparently authentic instance of dog-fox cross and of cross between this hybrid and a coyote. Photographs.)

RACHFORD, C. E. Regulated hunting on the Pisgah. Amer. Forests, vol. 39, no. 3, p. 99–102. March, 1933. (An experiment in conserving deer herds by reducing excess population through controlled hunting.)

RALL, IURII. Zur winterbiologie der Sandmaus (*Gerbillus tamaricinus* Pall.) und anderer Nager aus der umgegend der Stadt Urda. Rev. Microbiol., Épidémiol. et Parasitol., vol. 10, no. 2, pp. 189–202. 1931. (In Russian, with German summary.)

RAND, A. L. Notes on the mammals of the interior of western Nova Scotia. Canadian Field-Nat., vol. 47, no. 3, p. 41–50. March, 1933.

RAUP, HUGH M. Range conditions in the wood buffalo park of western Canada with notes on the history of the wood bison. Amer. Comm. for International Wild Life Prot., Special Publ., vol. 1, no. 2, pp. 1–52. 1933.

RÉCAMIER, JOSEPH. Histoire d'un métis de chien et de loup précédée d'un hommage a G. Hervé. Revue anthropologique, Paris, année 43, nos. 1–3, pp. 125–130. January–March, 1933.

REYNOLDS, T. EMMETT. New insectivores from the Lower Paleocene. Bull. Geol. Soc. America, vol. 42, no. 1, p. 368. March, 1931. (Abstract.)

RICHMOND, R. D. Elephants—Age to which they live in captivity. Journ. Bombay Nat. Hist. Soc., vol. 36, no. 2, pp. 494–496. April 15, 1933. (Of the 78 elephants over 20 years of age in possession of Madras Forest Department, 16 are over 40 years of age, 7 over 50 years, and only 1 over 60 years.)

RIGGS, ELMER S. Preliminary description of a new marsupial sabertooth from the Pliocene of Argentina. Geol. Ser. Field Mus. Nat. Hist., vol. 6, pp. 61–66. December 11, 1933. (New: *Thylacosmilus, T. atrox*, and *T. lentis.*)

RITCHIE, JAMES. The musk-rat in Britain. Nature, London, vol. 131, no. 3307, pp. 385–387, figs. 3. March 18, 1933.

ROBERTS, AUSTIN: Eleven new forms of South African Mammals. Annals Transvaal Mus., vol. 15, pt. 2, pp. 265–270. August 1, 1933. (New: *Macroscelides proboscideus chiversi, Macroscelides proboscideus langi, Atilax paludinosus transvaalensis, Malacothrix typicus molopensis, Parotomys brantsi deserti, Parotomys (Liotomys) littledalei molopensis, Parotomys (Liotomys) littledalei namibensis, Thallomys leuconoe bradfieldi, Thallomys leuconoe molopensis, Thallomys stevensoni, Pronolagus crassicaudatus australis.*)

ROE, R. J. Supernumerary horns of Cyprus sheep. Cyprus Agric. Journ., vol. 27, pt. 1, pp. 28–29, figs. 2. March, 1932.

ROTHSCHILD, LORD, and GUY DOLLMAN. On mammals collected in Dutch New Guinea by Mr. F. Shaw Mayer in 1930. Proc. Zool. Soc. London for 1933, pt. 1, pp. 211–219, pls. 1–4. March 31, 1933. (New: *Mallomys weylandi, M. argentata, Melomys mayeri, Dactylopsila megalura, Pseudochirus mayeri, Phascogale brevicaudata.*)

RUSCONI, CARLOS. Anatomía craneodental de los tayassuinos vivientes (pecaríes). Anales Soc. Cient. Argentina, Buenos Aires, vol. 107, pp. 1–75, figs. 21, pls. 9. 1929.

———. Apuntes preliminares sobre las Arenas Puelchenses y su Fauna. Anales Soc. Cien. Argentina, Buenos Aires, vol. 116, pp. 169–193, figs. 8. October, 1933. (New: *Hydrochoeropsis fontanai, Macrocavia, M. simpsoni, Notopachyrucos, N. tambuttoi.*)

———. Datos sobre una Capa Marina de Edad Pampeana descubierta en Olivos, Provincia de Buenos Aires, con un Nota sobre la Ingresión Interensenadense. Anales Soc. Argentina Estud. Geográf. GAEA, Buenos Aires, vol. 4, no. 1, pp. 29–39, figs. 3. 1932. (*Arctotherium* and *Scelidotherium.*)

RUSSELL, L. S. Paleocene vertebrates from Alberta. Amer. Journ. Sci., vol. 17, pp. 162–178. February, 1929. (New: *Ptilodus cochranensis, Diacodon septentrionalis, Ectocion collinus, Chriacus orthogonius, Meniscotherium semicingulatum.*

———. The Cretaceous-Tertiary transition of Alberta. Trans. Roy. Soc. Canada, Ottawa, ser. 3, vol. 26, sec. 4, pp. 121–156. 1932. (Faunal lists include mammalian forms.)

RUSSELL, LORIS S., and R. T. D. WICKENDEN. An upper Eocene vertebrate fauna from Saskatchewan. Trans. Roy. Soc. Canada, Ottawa, ser. 3, sect. 4, vol. 27, pp. 53–65, fig. 1, pl. 1. November 4, 1933. (New: *Hyopsodus fastigatus.*)

SANBORN, COLIN CAMPBELL. Bats from Szechwan and Kweichow, China. Proc. Biol. Soc. Washington, vol. 46, pp. 55–56. March 24, 1933.

SANFORD, J. T. Richmond mastodon. Bull. Geol. Soc. America, vol. 44, no. 1, p. 200. February 28, 1933. (Abstract.)

SCHLAIKJER, ERICH M. A detailed study of the structure and relationships of a new zalambdodont insectivore from the Middle Oligocene. Bull. Mus. Comp. Zool. Harvard College, vol. 76, no. 1, pp. 1–27, figs. 8, pl. 1. November, 1933. (New: *Apternodus gregoryi.*)

SCHMIDT, FRITZ. Ueber Polygamie und polygame Methoden in der Silberfuchszucht. Der Deutsche Pelztierzüchter, Jahrg. 8, pp. 25–29. January 15, 1933. (On the Soviet farms the proportion of males to females is now 1:3. It is expected that 1:5 will soon be found practicable.)

SCHOUTEDEN, H. Le Chimpanzé de la rive gauche du Congo. Bull. Cercle Zool. Congolais (Suppl. Rev. Zool. Bot. Afr.), vol. 20, no. 4, pp. 114–119, figs. 4. June 15, 1931.

SCHROEDER, HENRY. Über Elephas antiquus und trogontherii aus dem Diluvium der Mittelmark. Jahrb. Preuss. Geol. Landesanst., Berlin, vol. 48, pp. 699–723, pl. 3, fig. 1. (1927) 1928. (New: *Elephas primigenius pachyganalis.*)

SCHULTZ, ADOLPH H. Notes on the fetus of an orang-utan with some comparative observations. Report Laboratory & Mus. Compar. Pathology, Zool. Sec., Philadelphia, pp. 28–39, fig. 1, pl. 1933.

———. Die Körperproportionen der erwachsenen catarrhinen Primaten, mit spezieller Berücksichtigung der Menschenaffen. Anthropologischer Anzeiger, München, Jahrg. 10, nos. 2–3, pp. 154–185, figs. 5–8, pl. 1. September, 1933.

SCHWARZ, ERNST. Über diluviale Pferde der Equus caballus-Gruppe. Jahrb. Preuss. Geol. Landesanst. Berlin, vol. 48, pp. 429–476, pls. 5, figs. 4. 1927 (1928).

SHULER, ELLIS W. Frequency of vertebrate fossils in river deposits. Science, n.s., vol. 77, no. 1998, pp. 368–369. April 14, 1933.

SIMMONS, R. M. Jackal attacking goat. Journ. Bombay Nat. Hist. Soc., vol. 36, no. 2, pp. 490–491. April 15, 1933.

SIMPSON, G. G. Skull of the extraordinary Patagonian Eocene ungulate, Trigonostylops. Bull. Geol. Soc. America, vol. 44, no. 1, p. 198. February 28, 1933. (Abstract.)

———. The supposed fossil marsupial from Africa. Natural History, New York, vol. 33, no. 1, pp. 106–107. January–February, 1933.

———. A day in Patagonia. Collecting remains of prehistoric animals in southernmost South America. Natural History, vol. 33, no. 2, p. 187–198. March-April, 1933.

———. Structure and affinities of Trigonostylops. Amer. Mus. Novitates no. 608, pp. 28, figs. 10. April 11, 1933.

———. Braincasts of Phenacodus, Notostylops, and Rhyphodon. Amer. Mus. Novitates no. 622, pp. 19, figs. 3. May 23, 1933.

SKINNER, CURTIS. The beaver rescue. Yellowstone Nat. Notes, vol. 10, nos. 1–2, p. 3. January–February, 1933.

SLODKEWITSCH, W. S. Über die Reste des Cuon aus den Quartären Ablagerungen der Höhle von Nishneudinsk. Travaux Inst. Paléozool. Acad. Sci. URSS, vol. 2, pp. 277–282, pl. 26. (1932) 1933. (In German, with Russian resumé.)

SOWERBY, ARTHUR DE C. The tiger in China. China Journal, vol. 18, no. 2, pp. 94–101, 108–109. February, 1933.

———. Sixteen deer for local restaurant. China Journ., vol. 18, no. 3, p. 168, figs. 2. March, 1933. (*Hydropotes inermis*.)

———. Wolves in Chinkiang. China Journ., vol. 18, no. 4, pp. 213–214, fig. 1. April, 1933.

———. Horns of a new deer and other relics from the waste of Yin, Honan, China. China Journ., vol. 19, no. 3, pp. 141–144, figs. 2. September, 1933. (New: *Cervus* (*Rucervus*) *menziesianus*. Semi-fossilized horns obtained from pit.)

STEJERNMAN, ROBERT O. G. Vergleichend-anatomische Studien über die Extremitäten-Muskulatur (Vorder- und Hintergliedmassen) bei *Tapirus indicus* ♀ ad. et juv. Lunds Univ. Årsskrift, N.F., Avd. 2, vol. 28, no. 2, pp. 1–154, pls. 22. 1932.

STEWART, A. M. The problem of variation in the colour of the mole. Scottish Nat., no. 200, pp. 39–44. March–April, 1933.

STIRTON, R. A. Castoridae from the Tertiary of Nevada. Bull. Geol. Soc. America, vol. 43, no. 1, p. 288. March, 1932. (Abstract.)

ST. LEGER, J. On mammals from North-west Damaraland, South-west Africa, obtained during Captain Shortridge's sixth Percy Sladen and Kaffrarian Museum expedition. Proc. Zool. Soc. London, pp. 957–974, pl. 1. January 6, 1933.

STOCK, CHESTER. Exploration of Gypsum Cave, Nevada. Bull. Geol. Soc. America, vol. 42, no. 1, p. 364. March, 1931. (Abstract.)

———. Occurrence of human remains in Conkling Cavern, New Mexico. Bull. Geol. Soc. America, vol. 42, no. 1, p. 370. March, 1931. (Abstract.)

———. Quaternary antelopes of Shelter Cave, New Mexico. Bull. Geol. Soc. America, vol. 42, no. 1, p. 364. March, 1931. (Abstract.)

———. Is Felis atrox of Rancho La Brea a lion or a tiger? Bull. Geol. Soc. America, vol. 43, no. 1, p. 290. March, 1932. (Abstract.)

———. Carnivora of the Sespe Upper Eocene, Simi Valley region, California. Bull. Geol. Soc. America, vol. 44, no. 1, p. 199. Feb. 28, 1933. (Abstract.)

STOCK, CHESTER. Upper Eocene mammals from the Sespe, north of the Simi Valley, California. Bull. Geol. Soc. America, vol. 44, no. 1, p. 158. February 28, 1933. (Abstract.)

———. Upper Oligocene mammalian fauna from the Sespe of the Las Posas Hills, California. Bull. Geol. Soc. America, vol. 44, no. 1, p. 158. February 28, 1933. (Abstract.)

———. Hyaenognathus from the Late Pliocene of the Coso Mountains, California. Bull. Geol. Soc. America, vol. 44, no. 1, p. 218. February 28, 1933. (Abstract.)

———. An amynodont skull from the Sespe deposits, California. Proc. Nat. Acad. Sci., vol. 19, no. 8, pp. 762–767. 1933. (New: *Amynodontopsis, A. bodei.*)

———. Hyaenodontidae of the Upper Eocene of California. Proc. Nat. Acad. Sci., vol. 19, no. 4, pp. 434–440. 1933. (New: *Hyaenodon vetus, Protohyaenodon, Hyaenodon (Protohyaenodon) exiguus,* and *Pterodon californicus.*)

STOCKLEY, C. H. In quest of India's strangest species. Shooting the elusive serow in Kumaon. Field, London, vol. 161, no. 4180, p. 200. February 4, 1933.

STRAELEN, V. VAN. Louis Dollo (1857–1931). Notice biographique avec liste bibliographique. Bull. Mus. Roy. d'Hist. Nat. Belgique, Bruxelles, vol. 9, no. 1, pp. 29, pl. 1. January, 1933.

SVIHLA, ARTHUR. Notes on the deer-mouse, *Peromyscus maniculatus oreas* (Bangs). Murrelet, vol. 14, no. 1, pp. 13–14. January, 1933.

———. An accurate method for measuring new-born mice. Science, n.s., vol. 77, no. 1996, p. 331. March 31, 1933.

SVIHLA, ARTHUR, and RUTH D. SVIHLA. Mammals of Clallam County, Washington. Murrelet, vol. 14, no. 2, pp. 37–41. May, 1933.

THIGPEN, LORNA W. Comparative histological studies on hairless mammals, with some genetic notes. Univ. Pittsburgh Bull., vol. 27, no. 3, pp. 191–197. 1930.

THOM, W. S. Some experiences amongst elephant and the other big game of Burma from 1887 to 1931. Journ. Bombay Nat. Hist. Soc., vol. 36, no. 2, pp. 321–333, pls. 2. April 15, 1933. (Predicts big-game animals will become extinct in following order: *Tapirus indicus, Rhinoceros sondaicus & R. sumatrensis, Cervus eldi* (thamin), *Cervus porcinus, Bibos sondaicus* (tsine, banting), *Bibos gaurus* (gaur), and *Elephas maximus.*)

TODD, T. WINGATE. Hereditary and environmental factors in facial development. Internat. Journ. Orthodontia, Oral Surg. & Radiography, St. Louis, vol. 18, no. 8, pp. 799–808. August, 1932.

TODD, T. WINGATE and F. P. SCHWEIKHER. The later stages of developmental growth in the Hyaena skull. Amer. Journ. Anat., vol. 52, no. 1, pp. 81–123, figs. 14. January 15, 1933.

TRAUT, I. I. A comparison of the value of ground squirrel extermination methods. Bull. Plant Protection, vol. 4, no. 1, pp. 33–58. 1931. (In Russian, with English summary.)

TROUGHTON, ELLIS G. The egg-laying furred animals of Australia. Mid-Pacific Mag. Honolulu, vol. 45, no. 4, pp. 358–364. April, 1933.

URSING, BJORN. Über Entwicklung und Bau des Hand- und Fuss-Skeletts bei *Bradypus tridactylus.* Lunds Univ. Årsskrift, N.F., Avd. 2, vol. 28, no. 12, pp. 108, figs. 63. 1932.

WEGELIN, H. Merkwürdige nasenparasiten des iltis, *Putorius foetorius* Cuv. Mitteil. der Thurgauischen Naturforsch. Gesellsch., vol. 28, pp. 159–166, figs. 1–4. 1930.

WEIGELT, JOHANNES. Neue Primaten aus der mitteleozänen (oberlutetischen) Braunkohle des Geiseltals (geborgen 1932 in den Gruben Cecilie und Leonhardt.) Nova Acta Abhandl. Kais. Leop.-Carol. Deutsch. Akad. Naturforscher, vol. 1, nos. 2–3, pp. 97–156, pls. 11, fig. 3. 1933. (New: *Megachiromyoides, M. schlüteri, Europolemur, E. klatti, Pseudoloris abderhaldeni, Megatarsius, M. abeli, Microtarsioides, M. voigti, Ceciliolemuroidea, Ceciliolemuridae.*)

WHITE, LESLIE A. The mentality of primates. Sci. Monthly, vol. 34, no. 1, pp. 69–72. January, 1932.

WILLIAMS, M. Y. Biological notes, covering parts of the Peace, Liard, Mackenzie, and Great Bear River basins. Canadian Field-Nat., vol. 47, no. 2, pp. 23–31. February, 1933. (Mammals, pp. 30–31.)

WILSON, ROBERT W. Pleistocene rodent fauna from the Carpinteria asphalt deposits. Bull. Geol. Soc. America, vol. 44, no. 1, pp. 219–220. February 28, 1933. (Abstract.)

WOOD, ALBERT ELMER, and HORACE ELMER WOOD II. The genetic and phylogenetic significance of the presence of a third upper molar in a modern dog. Amer. Midland Nat., vol. 14, no. 1, pp. 36–48, figs. 1–3. January, 1933.

WOOD, HORACE ELMER, II. A fossil rhinoceros (*Diceratherium armatum* Marsh) from Gallatin County, Montana. Proc. U. S. Nat. Mus., vol. 82, art. 7, pp. 1–4, pls. 3. March 14, 1933.

WOODBURY, ANGUS M. Biotic relationships of Zion Canyon, Utah, with special reference to succession. Ecological Monographs, no. 3, pp. 147–246, figs. 29. April, 1933.

WOODWARD, HARRY R. How should we pronounce c-o-y-o-t-e? Yellowstone Nat. Notes, vol. 10, nos. 1–2, p. 7. January–February, 1933.

———. One animal disease transmissible to humans. Yellowstone Nat. Notes, vol. 10, nos. 1–2, p. 7–8. January–February, 1933. (Actinomycosis.)

WREFORD, R. G. Kashmir and its big game. Field, London, vol. 161, no. 4186, pp. 546–548, illus. March 18, 1933.

WRIGHT, GEORGE M., JOSEPH S. DIXON, and BEN H. THOMPSON. Fauna of the National Parks of the United States. A preliminary survey of faunal relations in national parks. Contrib. Wild Life Surv., Fauna ser. no. 1, Nat. Park Serv., U. S. Dept. Interior, pp. iv + 157, figs. 56. (May, 1932.) 1933.

YERKES, ROBERT M. Genetic aspects of grooming, a socially important Primate behavior pattern. Journ. Social Psychol., Worcester, Mass., vol. 4, no. 1, pp. 3–23. February, 1933.

YOUNG, C. C. Notes on the Mammalia remains from Kwangsi. Bull. Geol. Soc. China, vol. 8, no. 2, pp. 125–128, pl. 1929.

ZUCKERMAN, S. Sinanthropus and other fossil men. Their relations to each other and to modern types. Eugenics Review, vol. 24, no. 4, pp. 273–284. January, 1933.

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Anyone interested in any phase of mammalogy is eligible for membership in the American Society of Mammalogists, and if elected will receive the Society's official publication, the Journal of Mammalogy, quarterly. Name and address, with remittance of $3.00 for annual dues, may be sent to the Corresponding Secretary, or to any officer of the Society. Membership is dated from the nearest January, although formal election will not take place until the annual meeting of the Society following the receipt of application.